Indian Institute of Technology Kharagpur
Image Processing (CS40019)

Number of Students: 14
End-Semester Examination, November 2004 **Total Time: 3 Hours**
Maximum Marks: 100

Instructions: *All questions of the same part must be answered together. Clearly state any reasonable assumption that you make.*

Part A

Q1. Answer any *four* questions out of (a) – (e)

(a) What is meant by "pseudo-color image processing"? Mention one application of pseudo-color image processing and one method for performing pseudo-color image processing.
(b) What is "power-law transformation" in the context of gray-scale image enhancement? Mention one application of power law transformation explaining the steps.
(c) Prove that the morphological operations dilation and erosion are duals of each other with respect to set complementation and reflection.
(d) What is meant by "texture" in an image? Suggest one method for extracting an image texture.
(e) What is bit-plane slicing? Mention one application of bit-plane slicing explaining the steps.

[5X4=20]

Part B

Answer any five questions from this part

Q2. Consider the following image gray level values. Write the LL, HL, LH and HH band coefficients after performing complete two-dimensional Haar Wavelet Transform. You need not further decompose the LL band. **[10]**

10	**15**	**20**	**20**	**20**	**20**	**2**	**2**
10	**15**	**20**	**20**	**20**	**20**	**2**	**2**
10	**15**	**20**	**20**	**20**	**20**	**2**	**2**
10	**15**	**20**	**20**	**20**	**20**	**2**	**2**
90	**95**	**80**	**80**	**20**	**20**	**2**	**2**
90	**95**	**80**	**80**	**20**	**20**	**2**	**2**
90	**95**	**80**	**80**	**20**	**20**	**2**	**2**
90	**95**	**80**	**80**	**20**	**20**	**2**	**2**

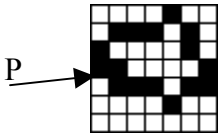
Q3. Consider the following sequence of numbers.

2, 5, 8, 9, 7, 4, -1, 1

Write the output of Daubechies' Wavelet Transform on the above sequence of numbers where the Low Pass Filter coefficients are given below. Assume the sequence of numbers to have come from a periodic signal.

$$\mathbf{C = (c(0), c(1), c(2), c(3))} = \frac{1+\sqrt{3}}{4\sqrt{2}}, \frac{3+\sqrt{3}}{4\sqrt{2}}, \frac{3-\sqrt{3}}{4\sqrt{2}}, \frac{1-\sqrt{3}}{4\sqrt{2}}$$ **[10]**

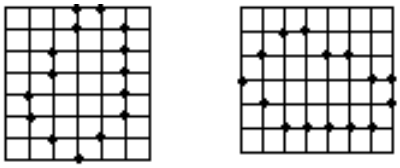
Q4. Consider the following image. Suggest a suitable structuring element and an iterative expression for the morphological operations by which the connected component can be extracted. Using this expression and starting with the point marked P, draw the sequence of images identifying the part of the connected component extracted at each stage. **[3+7=10]**



Q5. Consider the following gray level distribution in a part of an image. Determine the magnitude and direction of edge at the center pixel position using Sobel mask. **[10]**

80	**60**	**70**
50	**30**	**20**
20	**10**	**30**

Q6. Consider the following two images showing digital boundaries. For these two images, (a) Write the 4-directional chain code representation that is normalized with respect to the starting point (b) Write the first difference of the chain codes and comment on the results. **[5+5=10]**



Q7. Consider the following six points on the boundary of an image region: (0,0), (2,0), (4,0), (4,4), (2,4) and (0,4). Evaluate the Fourier descriptors for this region. If we choose to retain only the first 4 descriptors, what would be the new set of boundary points obtained by the inverse operation? Comment on the result. **[4+4+2=10]**

Part C

Answer any two questions from this part

Q8.

(a) What are meant by "lossy" and "lossless" compression of images?
(b) Define the measures for evaluating performance of a compression scheme of still images.
(c) Describe the basic algorithm for JPEG lossy compression of still images. **[2+4+9=15]**

Q9. Write short notes on (*any two*)

(a) Homomorphic filtering for image enhancement
(b) Fractal compression and decompression of images
(c) Computation of Discrete Cosine transform (DCT) of a finite sequence using Fast Fourier Transform (FFT) algorithm
(d) Gaussian filtering of images **[7.5X2=15]**

Q10.

(a) Define Hadamard Transformation Matrix for an input data of length $N=2^n$, where n is a positive integer. Discuss about an efficient algorithm for computing Hadamard Transformation with O(NlogN) time complexity.
(b) Discuss about an algorithm for lossless image compression. **[5+5+5=15]**