

## CSPE 74 – IMAGE PROCESSING AND ITS APPLICATIONS

Date: 10-11-25

Duration: 3 Hrs

Mark: 40 marks

## ANSWER ALL THE QUESTIONS

1. a) Convert the RGB (29,104,215) values to HSI values. (Use Normalized RGB values with the range [0,1]). (2)

b) Consider the two image subsets  $S_1$  and  $S_2$  in the following figure. Assume that  $V = \{1\}$ , determine whether these two subsets are (3)

(1) 4-adjacent. (2) 8-adjacent (3) m-adjacent

|   |       |   |   |   |       |   |   |   |   |
|---|-------|---|---|---|-------|---|---|---|---|
|   | $S_1$ |   |   |   | $S_2$ |   |   |   |   |
| 0 | 0     | 0 | 0 | 0 | 0     | 0 | 1 | 1 | 0 |
| 1 | 0     | 0 | 1 | 0 | 0     | 1 | 0 | 0 | 1 |
| 1 | 0     | 0 | 1 | 0 | 1     | 1 | 0 | 0 | 0 |
| 0 | 0     | 1 | 1 | 1 | 0     | 0 | 0 | 0 | 0 |
| 0 | 0     | 1 | 1 | 1 | 0     | 0 | 1 | 1 | 1 |

c) Given a 1D signal:  $f(x) = [3, 7, 5, 2]$ . Compute the 1D Discrete Fourier Transform (DFT) of the signal. (2)

d) Find the Haar transform of the following signal, (1)

$$f(m, n) =$$

|   |    |
|---|----|
| 4 | -1 |
| 2 | 3  |

2. a) The two images shown in the figure (Image A and Image B) are quite different. Would their histograms be the same? Explain. (2)



Image A

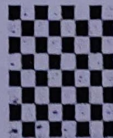


Image B

b) A medical X-ray image appears too dark to interpret accurately. Explain how image transformations like logarithmic and gamma enhance the visibility of details. (2)

c) In an application, an averaging mask is applied to input images to reduce noise, and then a Laplacian mask is applied to enhance small details. Would the result be the same if the order of these operations were reversed? Justify your answer with an example. (2)

d) Given the noisy image below (salt-and-pepper noise added):

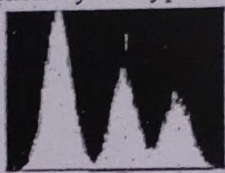
$$I(x, y) = \begin{bmatrix} 10 & 250 & 10 \\ 10 & 15 & 250 \\ 15 & 10 & 10 \end{bmatrix}$$

Compute the output when:

i. A  $3 \times 3$  mean filter is applied.

ii. A  $3 \times 3$  median filter is applied. (2)

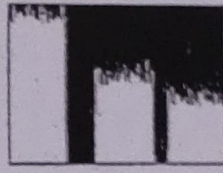
3. a) Identify the type of noise present in the following plots. (2)



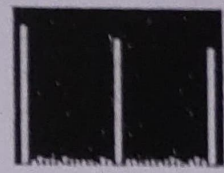
(a)



(b)



(c)



(d)

b) What do you mean by order static filters? Explain the different types of order static filters. (3)

c) Perform Geometric mean, Harmonic mean and Contra Harmonic mean filter (Assume  $Q = 2$ ), for the given image, with pixel values ranging from 0 to 255: (3)

|     |     |     |
|-----|-----|-----|
| 20  | 25  | 30  |
| 40  | 10  | 55  |
| 100 | 120 | 150 |

4. a) Consider the simple 4 X 8, 8-bit image:

|    |    |    |     |     |     |     |
|----|----|----|-----|-----|-----|-----|
| 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 95 | 169 | 243 | 243 | 243 |
| 21 | 21 | 95 | 169 | 243 | 243 | 243 |

i) Compute the entropy of the image. ii) Compress the image using Huffman coding. iii) Compute the compression achieved and the effectiveness of the Huffman coding. (3)

b) Explain Bit-plane coding with an example. (2)

c) Compute the Mean Squared Error (MSE) and Signal to Noise ratio (SNR) for the original input image. (3)

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 1  | 0  | 2  | 3  | 3  | 4  |
| 13 | 12 | 10 | 11 | 15 | 12 |
| 9  | 9  | 6  | 6  | 3  | 4  |
| 2  | 4  | 8  | 9  | 10 | 7  |
| 5  | 5  | 14 | 14 | 15 | 15 |

Original Image

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 1  | 0  | 2  | 2  | 3  | 2  |
| 11 | 10 | 10 | 10 | 15 | 10 |
| 9  | 9  | 6  | 6  | 3  | 4  |
| 2  | 4  | 8  | 9  | 10 | 7  |
| 5  | 5  | 11 | 11 | 12 | 12 |

Decompressed Image

$10 \cdot \log_{10}(E)$

5. a) Consider the following image. What is the result of the above image if the threshold value is 3? Calculate the percentage of white pixels in the matrix. (1)

|   |   |   |   |   |
|---|---|---|---|---|
| 1 | 1 | 9 | 8 | 7 |
| 0 | 1 | 8 | 8 | 8 |
| 0 | 0 | 7 | 9 | 8 |
| 0 | 1 | 8 | 8 | 9 |
| 1 | 2 | 8 | 8 | 9 |

b) Explain the steps involved in identifying plant leaf disease. (3)

c) What are the filter masks for: (i) Point Detection (ii) Horizontal line detection (iii) 45° diagonal line detection (iv) Vertical edge Sobel detection. (2)

d) How are edges detected in an image? What are the steps for implementing the Canny edge detection. (2)