

Image Processing

Time: 3 hrs. Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

1. a. With a neat block diagram, describe various components used in general purpose image processing system. (08 Marks)
   b. Briefly explain the principle of image formation in Human eye. (08 Marks)
   c. Let p and q be the pixels at coordinates (5, 5) and (10, 15) respectively. Find out which distance measure gives the minimum distance between the pixels. (04 Marks)

2. a. Explain the process of image sampling and quantization in digital image formation. (10 Marks)
   b. Explain: i) False contouring, ii) Checkerboard pattern. (05 Marks)
   c. Consider the image segment shown in Fig.Q2(c). Let \( V = \{2, 3, 4\} \), compute the length of shortest 4-, 8- and m-path between p and q. If any particular path does not exist between these two points, explain why? (05 Marks)

\[ \begin{array}{cccc}
3 & 4 & 1 & 2 \\
0 & 1 & 0 & 4 \\
2 & 2 & 3 & 1 \\
\end{array} \]

\[ \begin{array}{cccc}
\text{(q)} & 2 & 0 & 3 \\
1 & 2 & 0 & 3 \\
\end{array} \]

3. a. Consider a \( 2 \times 2 \) transform matrix \( A \) and the image \( U \), given below:

\[ A = \frac{1}{2} \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{3} \end{bmatrix}, \quad U = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \]

Calculate the transformed image \( V \) and the basis images. Check the image \( U \) using basis images and transformed image \( V \). (10 Marks)

b. Define Haar transform. Find Haar matrix for \( N = 8 \) and explain how it is constructed. State its properties. (10 Marks)

4. a. Explain the importance of discrete cosine transform with its equations and properties. (08 Marks)
   b. Write a short note on KL transform. (06 Marks)
   c. Prove that Hadamard transform is a fast transform. (06 Marks)

PART – B

5. a. Consider 8-level grey scale image of size \( 8 \times 8 \) shown in Fig.Q5(a). Show histogram of the image. Compute equalized histogram and display graphically. (10 Marks)

\[ \begin{array}{cccccccc}
0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\
0 & 1 & 2 & 3 & 3 & 2 & 1 & 0 \\
0 & 4 & 5 & 3 & 3 & 5 & 4 & 0 \\
0 & 1 & 2 & 7 & 7 & 2 & 1 & 0 \\
0 & 1 & 2 & 6 & 6 & 2 & 1 & 0 \\
0 & 4 & 5 & 3 & 3 & 5 & 4 & 0 \\
0 & 1 & 2 & 3 & 3 & 2 & 1 & 0 \\
0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\
\end{array} \]

Fig.Q5(a)
5 b. Using the second derivative, develop a Laplacian mask for image sharpening. (06 Marks)
c. Explain in brief any point processing technique implemented in image processing. (04 Marks)

6 a. Discuss the characteristics of high boost filter for both frequency and spatial domain. Explain how high boost filtering increases the enhancement of the image. (10 Marks)
b. With the help of block diagram, explain homomorphic filters for image enhancement. (10 Marks)

7 a. Explain different image degradation models. (06 Marks)
b. Explain in brief, the inverse filtering approach and its limitations. Explain how the limitations can be overcome using Wiener filtering. (10 Marks)
c. What is an order statistics filter? Explain any one such filter. (04 Marks)

8 a. Explain the following color models:
   i) RGB color model (10 Marks)
   ii) HSI color model
b. Write steps involved in converting colors from HSI to RGB. (05 Marks)
c. Explain pseudo color image processing in brief. (05 Marks)