Time : 3 hours   Full marks : 70

Answer any five questions

1. (a) The normalized gray-level histogram of an image with 8 levels is given below:

gray-level value	0	1	2	3	4	5	6	7
PDF	0	0.1	0.1	0.3	0	0	0.4	0.1

Compute the gray-level histogram of output image if the input is enhanced by histogram matching technique. The target histogram is given below:

gray-level value	0	1	2	3	4	5	6	7
PDF	0	0.1	0.2	0.4	0.2	0.1	0	0

(b) Show that the discrete transformation function $T(r)$ for histogram equalization satisfies the following conditions.

(i) $T(r)$ is single-valued and monotonically increasing in the interval $0 \leq r \leq 1$; and

(ii) $0 \leq T(r) \leq 1$ for $0 \leq r \leq 1$.   [10 + 4]

2. (a) For what types of images negative transformation is useful? What is the property of log transformation?

(b) What is the side effect of smoothing spatial filter and how do you reduce the same? What is meant by isotropic filters?

(c) Why the second derivative is better suited than the first derivative for image enhancement? Describe, how the Laplacian operator is used for image sharpening.

$$[(2 + 1) + (1 + 2) + (2 + 6)]$$

3. Consider the following gray-level values of an image:

9	8	7	7	7	5	5	5
7	7	7	7	4	4	5	5
6	6	6	9	9	9	6	6
6	6	7	7	7	9	9	9
3	7	7	8	8	8	3	3
3	3	3	3	3	3	3	3
10	10	11	7	7	7	6	6
4	4	5	5	5	2	2	6

Find out code words and average code length if the Huffman coding scheme is applied on the difference image. [14]

4. (a) Define morphological dilation and erosion operations. Prove that dilation and erosion are duals of each other with respect to set complementation and reflection; also show that the same is true for closing and opening morphological operations.
   (b) What are the application of morphological operations? Explain region filling with an example using morphological operation. [(3 + 5) + 6]

5. (a) Compare the Prewitt and Sobel operators.
   (b) Write the steps of Canny edge detection algorithm.
   c) Describe briefly edge linking method by proximity. [4 + 5 + 5]

6. (a) How can you make chain code based descriptor which is rotation invariant?
   (b) What is the advantage of using the Fourier descriptors to describe a shape? What are the properties of Fourier descriptors?
   (c) Obtain the gray-level co-occurrence matrix of a 5×5 image composed of a checkerboard of alternating 1's and 0's if the position operator P is defined as "one pixel to the right". Assume that the value of the top left pixel is 0.
   (d) What is the significance of the second moment of gray-level histogram?
   [2 + 4 + 5 + 3]

7. (a) Elaborate the terms 'global', 'local', and 'dynamic' threshold. If the threshold value is to be chosen automatically using iterative procedure, how could you choose the initial threshold value. What is the objective of choosing optimal threshold?
   (b) Describe the region growing technique for image segmentation and mention the problems associated with it. [(5 + 2 + 1) + 6]

8. What is the difference between Discrete Cosine Transform and K-L transform? Describe how the K-L transform can be used for image compression. [4 + 10]