

Time : 3 hours

Full marks : 70

**Answer any five questions**

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

Gray-level value	0	1	2	3	4	5	6	7
Frequency	3000	2000	1500	200	300	500	1000	1500

Compute the gray-level histogram of output image if the input is enhanced by histogram equalization technique.

b) Suppose that a digital image is subjected to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.

c) An image has the gray level PDF  $p_r(r)$  shown in the following figure. It is desired to transform the gray levels of this image so that they will have the specified  $p_z(z)$  shown in the Fig. 1. Assuming continuous quantities find the transformation (in terms of  $r$  and  $z$ ) that will accomplish this task. [7+ 4+ 3]

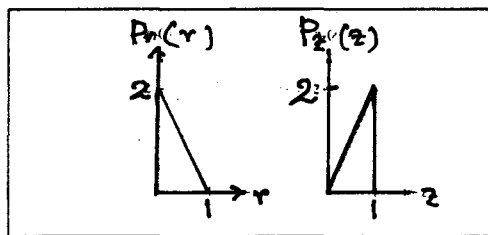


Figure 1:

2. Define image segmentation. Suppose there are two types of regions  $R_1$  and  $R_2$  in a gray level image. Gray-level of pixels that belong to  $R_1$  follows a Gaussian distribution with mean  $\mu_1$  and variance  $\sigma^2$ . Pixels belongs to  $R_2$  also follow a Gaussian distribution with mean  $\mu_2$  and same variance. If the probability that a pixel belongs to  $R_1$  is  $P_1$  and that for  $R_2$  is  $P_2$ , then find out the optimum threshold for image segmentation by gray-level thresholding.

3. (a) What are the different types of redundancies present in an image? Which coding method is effective for reducing spatial redundancy? [4]
- (b) Find out code words and average code length using Huffman coding scheme for set of events  $S_i$  with probabilities given below

Input	$S_1$	$S_2$	$S_3$	$S_4$	$S_5$	$S_6$	$S_7$	$S_8$
Probability	0.3	0.2	0.15	0.15	0.10	0.05	0.03	0.02

[10]

4. (a) Describe an algorithm for thinning. State the difference between medial axis and skeleton obtained through thinning.

(b) Define the Hit-and-Miss transform. What is the use of this transform. [(6 + 4) + 4]

5. (a) Compare the Prewitt and Sobel operators. [4]

(b) Chronologically write the steps of Canny edge detection algorithm. [5]

c) Describe briefly edge linking method by proximity. [5]

6. (a) Compute the first difference of the code 0101030303323232212111 and find its shape number. Assume that four connectivity is considered for obtaining the aforesaid code. [3]

(b) Draw the medial axis of a rectangle and an equilateral triangle. [4]

c) Describe with necessary diagram how a digital boundary can be approximated by a polygon using splitting technique. [7]

7. (a) Obtain the gray-level co-occurrence matrix of a  $5 \times 5$  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. [5]

(b) What are the different approaches to describe the texture of a region? How do you obtain the texture of a region using second order histogram moment? Define Euler number. [2 + 5 + 2]

8. Write short notes on:

(a) Discrete Cosine Transform

(b) Median filter

[9 + 5]