

**Ques 1.** Given the function shown in figure P1(a), the following operations are performed on it:

- (i) Dilation using the structuring element shown in figure P1(b)
- (ii) Erosion using the structuring element shown in figure P1(c)

Obtain the resulting function in each case. Write down the mathematical expression of the resulting function and also plot the resulting function. (6+6)

**Ques 2.** The following two operations are performed in sequence on an image: (i) image sharpening using the composite Laplacian mask followed by (ii) application of Sobel masks. Obtain the composite masks that represents resulting operation. (6)

**Ques 3.** Edge detection is performed on the image shown in figure P3 using the graph theoretic technique. The cost function is defined as  $c(p,q) = H - [f(p) - f(q)]$ . Assume that edges start from the leftmost column and ends at the rightmost column and that edge elements are defined such that  $p$  and  $q$  are 4-neighbours. Obtain the edge corresponding to the lowest cost path. (8)

**Ques 4.** For the one property, two classes case, what is the overall probability density of the property values in terms of the conditional probability densities. Use that expression to obtain the following:

- (i) Mean and variance of property value, given that the means and variances of the two conditional densities are  $\mu$  and  $\nu$  and  $\sigma^2$  and  $\tau^2$  respectively
- (ii) If the conditional densities are gaussian with mean and variance as given in (i) find the value of threshold which minimized the probability of mis-classification. Assume  $\sigma = \tau$ .
- (iii) Further assume that  $p(1) = p(2)$ , what is the condition for the probability of mis-classification being minimum rather than maximum (10)

**Ques 5.** Consider the image shown in figure P5. LZW encoding is applied on this image. The image pixels before encoding are represented using 3-bits each. The encoded values consist of 4-bit each. Obtain the encoded image and also the dictionary. In case the dictionary becomes full, re-initialize the dictionary and continue with this new initialized dictionary. (12)

**Ques 6.** Given the following symbol probabilities:

$$P(a) = 0.2, P(b) = 0.3, P(c) = 0.1, P(d) = 0.4$$

Obtain the input symbol sequence corresponding to the message 0.344365 (obtained by using arithmetic decoding). Consider a slight modification of the arithmetic encoding scheme where the sub-intervals (corresponding to symbols) are obtained by dividing the interval into equal parts rather than in accordance with the symbol probability. For this encoding scheme, obtain the encoded message corresponding to the input sequence decoded above. Why are the intervals divided in accordance with their probability of occurrence? (12)

Figure P1

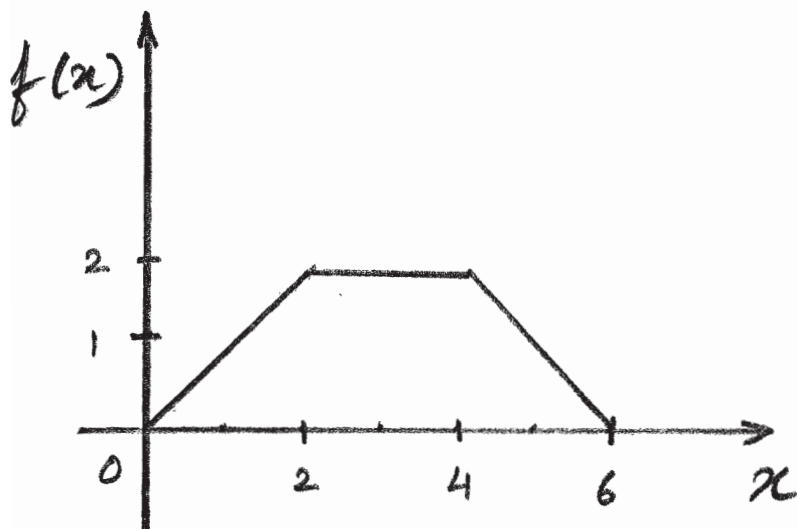


Figure P1 (a)

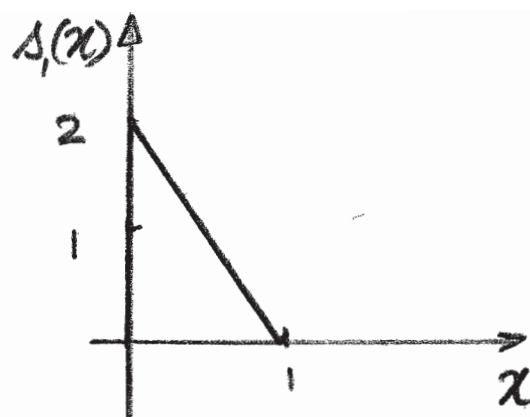


Figure P1 (b)

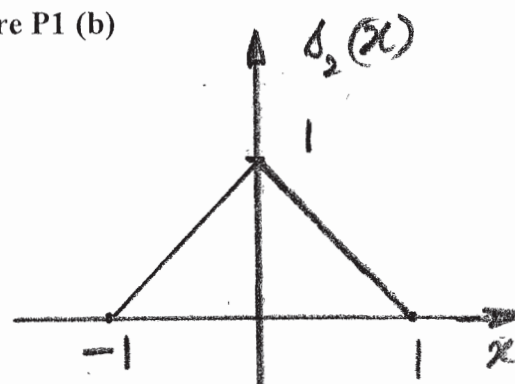


Figure P1 (c)

Figure P3

4	6	7	1
6	1	6	2
1	3	7	1
2	1	5	3

Figure P5

3	7	7	3
5	7	7	5
5	7	7	5
3	7	7	3