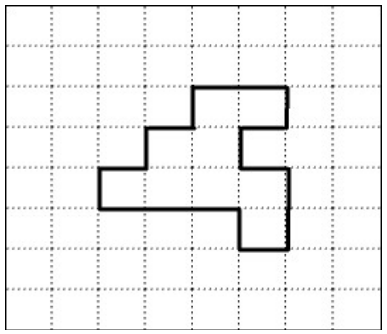
Group - E

8. (a) What are the applications of image-segmentation?

   (b) Distinguish between image segmentation based on thresholding with image segmentation based on region-growing techniques.

   (c) Obtain the 4-directional chain code, difference code and the shape number for the arbitrary-shape shown in figure below. Using the same figure, also show that the chain code is invariant to translation.



2 + 2 + 8 = 12

9. (a) Explain different shape features that can be extracted from 2D-images.

   (b) Compute the decision functions of a minimum distance classifier for the three classes of patterns with the mean vectors $m_1 = [1.5 \quad 0.3]^T$, $m_2 = [4.3 \quad 1.3]^T$ and $m_3 = [5.5 \quad 2.1]^T$, respectively. Sketch the decision surfaces implemented by the decision functions.

   (c) What are the differences between supervised and unsupervised classification approach?

4 + 6 + 2 = 12

DIGITAL IMAGE PROCESSING
(AEIE 5231)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) An example of an additive colour space is
   (a) RGB (b) HSI (c) CMY (d) YIQ.

   (ii) Digital images are displayed as a discrete set of
   (a) values (b) numbers (c) frequencies (d) intensities.

   (iii) Each element of a digital image is called
   (a) dots (b) coordinate (c) pixels (d) value.

   (iv) Compressed image can be recovered back by
   (a) image enhancement (b) image decompression
   (c) image contrast (d) image equalization.

   (v) The photosensitive 'detector' of human eye is the
   (a) eye lens (b) iris (c) retina (d) cornea.

   (vi) The basic principle of variable length coding is to
   (a) assign shorter code words to more probable symbols
   (b) assign longer code words to more probable symbols
   (c) assign uniform code words to least occurring symbols
   (d) assign uniform code words to more probable symbols.

   (vii) A continuous image is digitised at _____ points.
   (a) random (b) vertex (c) contour (d) sampling.

   (viii) A still image with uniform intensity exhibits
   (a) good spatial redundancy (b) poor spatial redundancy
   (c) good temporal redundancy (d) poor temporal redundancy.

(ix) Which of the following filters will in general have the best performance in enhancing edges in an image?
(a) mean filter (b) median filter
(c) laplacian filter (d) mode filter.

(x) The D_8 distance between the pixels (3, 8) and (10, 6) is
(a) 9 (b) 7 (c) 5 (d) 7.28.

Group - B

2. (a) What is meant by digial image? State the major fields of application of digital image processing.

(b) What does a chromaticity diagram indicate in colour image studies?

(c) Describe briefly the HSI colour model.

(2 + 2)+ 3 + 5 = 12

3. (a) What is the goal of an image transform? What is the advantage of Walsh transform over Fourier Transform?

(b) Compute the 2D DFT of the 4×4 gray scale image $f(m,n)$ given below.

$$f(m,n) = \begin{bmatrix} 1 & 2 & 0 & 3 \\ 2 & 0 & 1 & 4 \\ 0 & 1 & 2 & 1 \\ 2 & 1 & 3 & 0 \end{bmatrix}$$

(2 + 2) + 8 = 12

Group - C

4. (a) What is image negative? Explain how an image negative can be formed?

(b) Justify the statement "Median filter is an effective tool to minimize salt-and-pepper noise" through simple illustration.

(c) Compute the output pixel values at the position of marked pixel in the given image below due to a low pass filter, high pass filter, MAX filter, MIN filter and median filter using a 3×3 filter mask.

$$\begin{bmatrix} 2 & 1 & 3 & 4 & 5 \\ 1 & 2 & 0 & 1 & 3 \\ 2 & 0 & \textcircled{0} & 2 & 1 \\ 1 & 5 & 2 & 1 & 3 \\ 3 & 4 & 1 & 2 & 0 \end{bmatrix}$$

4 + 3 + 5 = 12

5. (a) Explain in brief the principle involved in histogram equalization technique.

(b) Suppose m be the gray level of input image which has to be transformed to output image gray level ℓ by histogram equalization technique. Consider an image of size 64×64 with 8 different gray levels and their distribution is shown in the table 1 below. Compute the distribution of the gray levels in the output image according to the rule $\ell = 7c_m$, where c_m is the cumulative probability and n_m is the number of pixels having gray level m.

Table 1

m	0	1	2	3	4	5	6	7
n_m	123	78	281	417	639	1054	816	688

2 + 10 = 12

Group - D

6. (a) What do you mean by coding redundancy? Find a set of Huffman code for the word 'COMMITTEE' and hence calculate entropy of the code words and compression ratio.

(b) What is run length coding? Explain with an example.

(c) What is 'blocking artifacts' in DCT-based transformed image compression scheme?

(2 + 5) + 3 + 2 = 12

7. (a) What do you understand by dilation and erosion in morphological operation? Explain in brief.

(b) Consider the following binary image shown in fig. below with object **A** and structuring element **B**. Compute the dilated image $A \oplus B$.

0	0	0	0	0	0
0	1	0	0	1	0
0	1	0	0	1	0
0	1	0	0	1	0
0	1	1	1	1	0
0	0	0	0	0	0

A

• 0	1
1	0

B

4 + 8 = 12