probabilities as given in table 1. Find the compression ratio using Huffman coding and data redundancy of original representation.

table 1

Gray level	0	1	2	3	4	5	6	7
Probabilities	0.1	0.15	0.30	0.25	0.06	0.05	0.04	0.05

(2 +2) + 8 = 12

Group – E

8. (a) Distinguish between local and global thresholding techniques for image segmentation. What is the difference between region splitting and region merging techniques of image segmentation?

(b) Consider an 8 × 8 image with gray levels ranging from 0 to 7 shown in fig. 1. Find out the segmented image obtained by region splitting technique, considering a threshold value $th = 3$ of the property

$$\text{Prop}(R): \max_{(r,c)\in R}\{g(r,c)\} - \min_{(r,c)\in R}\{g(r,c)\} \le th.$$

5	6	6	6	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
1	3	2	3	3	2	4	7
0	0	1	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	6

fig. 1

(4 +2) + 6 = 12

9. (a) What is meant by object description? Explain 4-chain code descriptor with example.

(b) What are the various approaches for pattern recognition?

(c) Compute the covariance matrix of the data given by $X_1 = [2 \quad 1]^T$, $X_2 = [3 \quad 2]^T$, $X_3 = [2 \quad 3]^T$ and $X_4 = [1 \quad 2]^T$

(2 + 2) + 3 + 5 =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) Which one of the following colour model is used for picture transmission?
(a) RGB (b) HSI (c) CMY (d) YIQ

(ii) Histogram is the technique processed in
(a) intensity domain (b) spatial domain
(c) frequency domain (d) undefined domain.

(iii) In 4-neighbours of a pixel p, how far are each of the neighbours located from p?
(a) One pixel apart (b) Four pixels apart
(c) Alternating pixels (d) None of the Mentioned.

(iv) The transform which possesses the 'multi-resolution' property is
(a) Fourier transform
(b) Short-time Fourier transform
(c) Discrete Cosine transform
(d) Wavelet transform.

(v) The number of shades of gray in a six-bit image is
(a) 256 (b) 128 (c) 64 (d) 32.

(vi) The parameter that may change if all the pixels in an image are shuffled is
(a) mean (b) entropy (c) histogram (d) covariance.

(vii) Cone vision is called
(a) scotopic vision (b) photopic vision
(c) photogenic vision (d) all of these .

(viii) Principal sensing categories of different lights in human eyes are
(a) red light 65%, green light 33%, and blue light 2%
(b) yellow light 65%, green light 33%, and blue light 2%
(c) red light 65%, green light 33%, and cyan light 2%
(d) none of above .

(ix) The process of embedding one image into another image is known as
(a) dithering (b) demosicing
(c) watermarking (d) beamforming.

(x) An example of unsupervised classifier is
(a) perceptron (b) backpropagation network
(c) support vector machine (d) self-organizing feature map.

Group – B

2. (a) What are the two aspects of human visual systems?

(b) What is meant by gray level? Distinguish between monochrome and gray scale image.

(c) Describe briefly the RGB colour model.

2 + (2 +2) + 6 = 12

3. (a) What is the effect of high pass filtering in an image? A 4×4 original image is given by

$$f(m,n)=\begin{bmatrix}2 & 6 & 3 & 4\\ 0 & 7 & 5 & 4\\ 3 & 2 & 1 & 6\\ 2 & 7 & 3 & 2\end{bmatrix}$$

Find the output image g (m, n) by applying 3 × 3 high pass filter mask on it.

(b) What is the output pixel value of the marked pixel after a 5 × 5 median filter mask is used on the given image below:

2	1	3	4	5
1	2	0	1	3
2	0	(0)	2	1
1	5	2	1	3
3	4	1	2	0

(2 + 7)+3 = 12

Group – C

4. (a) What are the purposes of edge detection?

(b) What is Laplacian edge detector?

(c) Describe the constrained least square error approach of image restoration technique.

2 + 4 + 6 = 12

5. (a) What is the difference between image restoration and image enhancement?

(b) What are the advantages of a Wiener filter over an inverse filter?

(c) A blur filter is given by:

$$h(m,n)=\begin{bmatrix}0 & 0.05 & 0.05 & 0\\ 0.15 & 0.1 & 0.1 & 0.15\\ 0 & 0.1 & 0.1 & 0\\ 0 & 0.1 & 0.1 & 0\end{bmatrix}$$

Find the deblur filter using Wiener filter approach with σ_x^2 = 200 and σ_w^2 = 100.

2 + 2 + 8 = 12

Group – D

6. (a) A line segment of an image is given by:

115, 118, 125, 120, 123, 126, 130.

Find the compressed and decompressed image sequence of it using a 1st order linear predictor.

(b) Apply block truncation coding (BTC) procedure to the following block of an image f (m, n)and obtain the reconstructed image block.

$$f(m,n)=\begin{bmatrix}75 & 80 & 70 & 65\\ 82 & 68 & 75 & 72\\ 65 & 62 & 72 & 84\\ 80 & 66 & 68 & 72\end{bmatrix}$$

6 + 6 = 12

7. (a) What are lossless and lossy compressions of image? What do you mean by transform coding of images?

(b) Find a set of code words and average word length using Huffman coding scheme for a set of input gray levels from 0 to 7 with