

- N.B.** (1) Question No. 1 is compulsory.  
 (2) Answer any four out of remaining six questions.  
 (3) Figures to the right indicate full marks.  
 (4) Assume any suitable data if necessary.

1. Justify/contradict following statements :— 20
- The first difference of chain code normalize it to rotation.
  - For continuous image histogram can be perfectly equalized, but it may not be so for digital image.
  - For digital image having salt-pepper noise median filter is best filter.
  - The statement "Run Length Coding gives Data Compression" is not always true.
  - Brightness discrimination is poor at low levels of illuminations.

2. (a) Gray Level Histogram of an image is given below :— 10

Gray Level	0	1	2	3	4	5	6	7
No. of Pixels	0	0	26	39	16	84	20	0

Compute gray level histogram of the output image obtained by enhancing the input by histogram equalization technique.

- (b) Explain in detail image compression model. 10
3. (a) Given below is the table of eight symbols and their frequency of occurrence. 10

Symbol	S <sub>0</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>
Frequency	0.25	0.15	0.06	0.08	0.21	0.14	0.07	0.04

Give Huffman Code for each eight symbols.

- (b) (i) Evaluate minimum number of average bits sequence per symbol. 3  
 (ii) What is coding efficiency for the code you have obtained in 3. (a). 3  
 (iii) How many unique Huffman codes are there for three symbol source ? Construct these codes. 4
4. (a) An image of size 5 × 5 quantized to 16 gray levels is given below. Operate on this image by any 2 edge extraction operators of size 3 × 3. Use appropriate threshold value. Give outputs before and after thresholding. Give your comments. 10

10	12	15	15	2
12	10	15	3	8
15	14	2	10	10
13	4	15	12	2
1	12	14	1	1

- (b) Explain the method of segmentation of images by region splitting and merging. 10
5. (a) Three column vectors are given below :—

$$\phi_0 = \begin{bmatrix} W^0 \\ W^0 \\ W^0 \end{bmatrix}, \quad \phi_1 = \begin{bmatrix} W^0 \\ W^1 \\ W^2 \end{bmatrix}, \quad \phi_2 = \begin{bmatrix} W^0 \\ W^2 \\ W^4 \end{bmatrix}$$

- (i) Prove that they are orthogonal. 4  
 (ii) Using these vectors generate (3 × 3) nine orthogonal patterns P<sub>ij</sub>(x, y), i, j, x, y = 0, 1, 2. 6
- (b) Obtain Hadamard matrix H(8) from simple second order matrix H(2) and draw flow diagram for H(8). Define sequency and find it for H(8). 10
6. (a) Explain different types of color models and where they are used. Also how to convert colors from RGB to HSI model. 10
- (b) Explain the use of following operators in Image Processing. Give mask of size (3 × 3) :— 10
- Sobel.
  - Prewitt,
  - Laplacian.

7. Write short notes on following (any four) :— 20
- Fourier Descriptor
  - Moments
  - Dilation and Erosion
  - Chain code
  - Discrete Cosine Transform
  - Connectivity of Pixels.