

7. (a) Mention the different steps employed in the coding of images using vector quantization.
- (b) What is lossy and lossless predictive coding? Using a 2nd order linear predictor model with appropriate coefficients, find the compressed and decompressed pixel sequence of following given image: 115, 118, 125, 120, 123, 126, 130, 137.

4 + (2 + 6) = 12

Group - E

8. (a) Distinguish between local and global thresholding techniques for image segmentation.
- (b) Give one representation scheme for the boundary of an object and describe how it can be computed.
- (c) What is clustering? Describe K-means clustering algorithm.
9. (a) State the Bay's rule and explain how it is applied to pattern classification problem.
- (b) Why feature selection is important in classification problem? State Fisher's criterion of feature selection method.
- (c) What is multilayer perceptron?

3 + 3 + 6 = 12

5 + 5 + 2 = 12

**DIGITAL IMAGE PROCESSING
(AEIE 5241)**

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) In formula $g(x,y) = T[f(x,y)]$, T is the
 (a) transformation function (b) transformation vector
 (c) transformation theorem (d) transformed image.
- (ii) The transform which possesses the highest 'energy compaction' property is,
 (a) Fourier transform (b) Walsh transform
 (c) Slant transform (d) K-L transform.
- (iii) Image enhancement traditionally included
 (a) smoothing (b) sharpening
 (c) degradation (d) both A and B.
- (iv) 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) Laplace filter (d) Mode filter.
- (v) What is the tool used in tasks such as zooming, shrinking, rotating, etc.?
 (a) Sampling (b) Interpolation
 (c) Filters (d) none of the mentioned.
- (vi) The operator which can be used to detect edges in an image is
 (a) logarithm (b) exponential
 (c) gradient (d) average.

- (vii) Which of the following is a lossy coding?
 - (a) Huffman coding
 - (b) Run-length coding
 - (c) Predictive coding without quantiser
 - (d) Uniform quantiser.
- (viii) The colour model which is more suitable for printing purposes is the
 - (a) RGB model
 - (b) CMY model
 - (c) HIS model
 - (d) YIQ model.
- (ix) An example of multilayer neural network is
 - (a) McCulloch-Pitts
 - (b) perceptron
 - (c) ADALINE
 - (d) MADALINE.
- (x) Bayes approach to pattern recognition fits into the category of
 - (a) structural approach
 - (b) statistical approach
 - (c) neural-network approach
 - (d) template matching.

Group - B

- 2. (a) Describe the components of an Image Processing system.
- (b) Determine the linear 2D-convolution between

$$x(m, n) = \begin{bmatrix} 3 & 1 & 2 \\ -1 & 0 & 1 \\ 2 & 1 & 1 \end{bmatrix}$$
 and $h(m, n) = \begin{bmatrix} 3 & 2 & -1 \\ 1 & 2 & 3 \end{bmatrix}$.
- (c) What is pseudo colour image processing?

2 + 7 + 3 = 12

- 3. (a) Discuss the salient features of Discrete Cosine transform? What is the advantage of DCT over Fourier Transform?

- (b) Check whether the DFT matrix $F = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$ is unitary or not.

- (c) Compute the 2D DFT of the 4x4 grayscale image $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$.

(2 + 2) + 4 + 4 = 12

Group - C

- 4. (a) What is histogram of an image? What information about image contrast and brightness can be obtained from the histogram?
- (b) A 5 x 5 original image is given below.

$$f(m, n) = \begin{bmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{bmatrix}$$

Find the output image by applying histogram equalization to the above image by rounding the resulting image pixels to integers.

- (c) If all the pixels of an image are shuffled, will there be any change in the histogram? Justify your answer with the above image.

(2 + 2) + 6 + 2 = 12

- 5. (a) What are smoothing and sharpening frequency domain filters?
- (b) Describe the constrained least square error approach of image restoration technique.
- (c) Explain how opening and closing operations are executed on an image? Where do you find applications of these operations useful?

4 + 4 + 4 = 12

Group - D

- 6. (a) Explain the Image compression models.
- (b) What do you mean by coding redundancy?
- (c) 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 probabilities as given in table 1. Find also compression ratio using Huffman coding and data redundancy of original representation.

Table 1

Gray level	0	1	2	3	4	5	6	7
Probabilities	0.02	0.15	0.03	0.15	0.05	0.20	0.10	0.30

3 + 2 + 7 = 12