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N.B.: (1) Question No. 1 is **Compulsory**.

(2) Attempt any **four** questions from remaining **six** questions.

(3) Assume suitable data wherever **necessary** and state it **clearly**.

1. (a) Determine a gray scale transformation that maps the darkest 5% of image Pixels to black (0), The brightest 10% of Pixels to white (255), and linearly transforms the graylevels of all remaining Pixels between black and white. 10
- (b) Show that the wiener filter does not restore the power spectral density of the object, where as the geometric mean filter does when $s = y_2$, compare the mean square errors of the two filters. 10
2. For the following 4 x 4 image, determine its forward and inverse transforms and compare the inverse transforms with the digized image data :— 20

2 0 1 0
1 1 0 1
1 0 0 1
2 1 2 3

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Use the following image transforms :—

- (i) The discrete Fourier transform
- (ii) The Hadamand transform
- (iii) The discrete cosine transform.

3. (a) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is damging to thin lines and sharp corners. 10

Give a 3 x 3 mask that can be used for medium filtering and does not exhibit this behaviour.

- (b) Show that the real and imaginary parts of the unitary DFT matrix are not orthogonal matrices in general. 10
4. (a) Take a 512 x 512 image containing noise. Design low-pass, bandpass, and high-pass zonal masks in different transform domains such that their passbands contain equal energy. 10
- (b) For the 2 x 2 transformed image A and the image U. 10

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$$A = \frac{1}{2} \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{3} \end{bmatrix}, U = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$$

Calculate the transformed image V and the basis images.

5. (a) The output of a binary source is to be coded in blocks of M Samples. If the successive outputs are independent and identically distributed with $P = 0.95$ (for a 0), find the Huffman Code for $M = 1, 2, 3, 4$ and calculate their efficiency. **muadda.com** 10
- (b) Show that the $N \times N$ Cosine transform matrix C is orthogonal. Verify your proof for the case $N = 4$. 10
6. (a) Describe and differentiate point, line and edge detection. Also explain region orientation segmentation. 10
- (b) What are morphological operations ? For a region explain Boundary extraction operation and then region filling operation on the extracted boundary. 10
7. Write short notes on the following :— 20
- (a) Uniform and Nonuniform Sampling **muadda.com**
 - (b) Translation, Scaling and Rotation
 - (c) Properties of DFT
 - (d) Variable Length Coding
 - (e) Image Restoration.

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