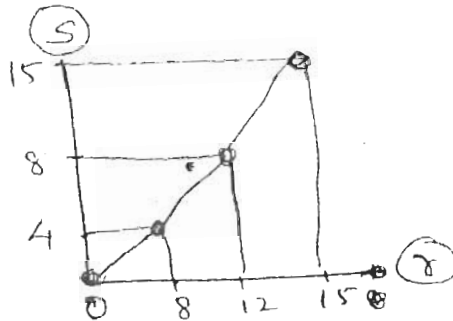


- N.B.:** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions out of remaining **six** questions.
 (3) Assume **suitable** data wherever **required** and clearly specify it

1. (a) Prove that two Dimensional Fourier Transform Matrix is an unitary matrix. 20
 (b) Derive 8 Directional Laplacian filter mask (3 x 3).
 (c) Derive matrix representation of one Dimensional Walsh transform for N = 4 from forward Walsh transformation function.
 (d) State fidelity objective and subjective criteria of Image evaluation.
2. (a) Let $X(k) = \{1, -2, 1-j, 2j, 0, \square, \square, \square\}$ is the 8 point DFT of a real valued sequence $x(n)$. 6
 (i) What is 8 point DFT $P(k)$ such that $P(n) = (-1)^n x(n)$?
 (ii) What is 8 point DFT $Q(k)$ such that $q(n) = (-1)^{n-4} x(n-4)$?
 (b) Derive the equation of contrast stretching transformation function as given in **figure** below. Apply the contrast stretching transformation function on the input image F and obtain the output image R . 6



$$F = \begin{bmatrix} 7 & 12 & 2 & 3 & 4 \\ 10 & 15 & 1 & 6 & 7 \\ 12 & 4 & 6 & 15 & 12 \\ 8 & 2 & 7 & 15 & 2 \\ 11 & 13 & 3 & 3 & 5 \end{bmatrix}$$

(c) Given $F = \begin{bmatrix} 13 & 54 & 12 \\ 13 & 11 & 57 \\ 11 & 10 & 12 \end{bmatrix}$.

8

- (i) Find 3 bit IGS coded image and calculate compression factor and bits per pixel (BPP).
- (ii) Find decoded image and calculate MSK and PSNR.

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3. (a) Given $h(n) = \{1, 2\}$ find the response of the system to the input $x(n) = \{1, 2, 3\}$ 6
using FFT - IFFT.

(b) Given $F = \begin{bmatrix} 2 & 3 & 5 & 10 \\ 4 & 6 & 4 & 10 \\ 7 & 1 & 3 & 3 \end{bmatrix}$ 6

Determine the output image using power law transformation $s = (r)^2$.

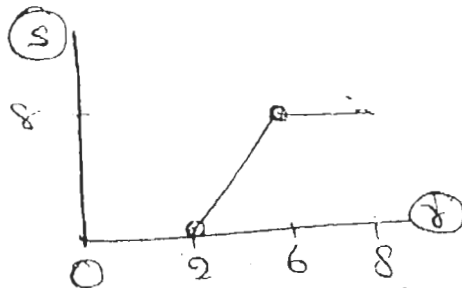
- (c) Segment the following given image such that the difference between the maximum intensity value and minimum intensity value in the segmented region is less than 18 using split and merge technique. 8

$$R = \begin{bmatrix} 10 & 9 & 30 & 4 \\ 7 & 6 & 33 & 37 \\ 54 & 52 & 54 & 53 \\ 55 & 57 & 56 & 58 \end{bmatrix}$$

4. (a) Let $x(n)$ be Four point sequence with $X(k) = \{1, 2, 3, 4\}$. Find the DFT of the 6
following sequence using $X(k)$.
(i) $P(n) = x(n) \cos(n\pi/2)$
(ii) $q(n) = 2\delta(n) + 3\{\text{Four point } u(n)\} + 4x(n)$.

(b) Given $F = \begin{bmatrix} 2 & 5 & 3 & 5 \\ 3 & 6 & 5 & 3 \\ 3 & 5 & 2 & 4 \\ 2 & 5 & 4 & 5 \end{bmatrix}$ 8

- (i) If the gray level intensity changes are to be made as shown in figure below, derive the necessary expression for obtaining the new pixel value using slope.



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- (ii) Obtain the new image by applying the above mentioned transformation function.
- (iii) Plot the Histogram of Input and Output image.
- (iv) Compare the Histogram of input and output image.

(c) Given $F = \begin{bmatrix} 6 & 5 & 7 \\ 2 & 8 & 4 \\ 6 & 3 & 7 \end{bmatrix}$

6

Apply the following filter mask W_1 , W_2 and W_3 on the input image F and obtain the output image.

5. (a) Given $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Find the response of the system to the input

6

$x(n) = \left(\frac{1}{4}\right)^n u(n)$ using Z-transform method.

- (b) Explain Trimmed average filter find the Trimmed average value of the input image F at the center position for $R=2$ and $S=1$ where R is the number of consecutive pixels to be trimmed from the minimum extreme and S is the number of consecutive pixels to be trimmed from maximum extreme.

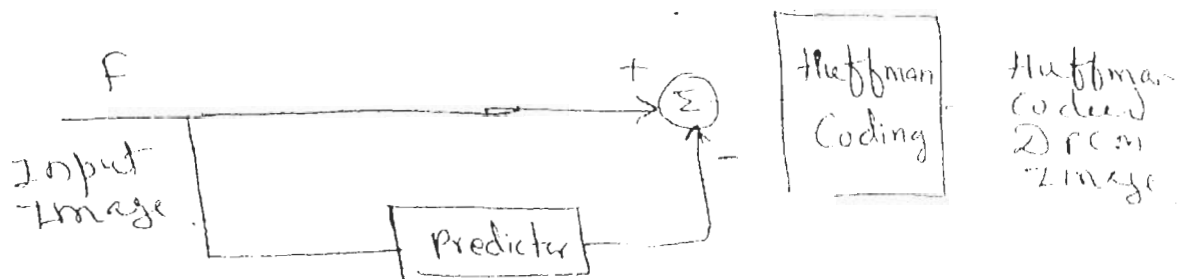
6

$F = \begin{bmatrix} 12 & 70 & 25 \\ 60 & 65 & 55 \\ 90 & 120 & 200 \end{bmatrix}$

(c) Given $F = \begin{bmatrix} 10 & 10 & 40 & 40 \\ 20 & 20 & 20 & 30 \\ 30 & 30 & 40 & 40 \\ 50 & 50 & 60 & 80 \end{bmatrix}$

8

- (i) Find the Huffman coded image of the following encoder.



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(ii) Calculate Bits per pixel (BPP) and percentage of compression of compressed image. Do not consider the payload of Huffman Table.

6. (a) $x(t) = \sin(480 \pi t) + 3 \sin(720 \pi t)$ is sampled with $F_s = 600$ Hz. 6
- (i) What are the frequencies in radians in the resulting DT signal $x(n)$.
- (ii) If $x(n)$ is passed through an ideal interpolator, what is the reconstructed signal.
- (b) Applying Horizontal and Vertical line detection mask on the following image F . 6
Use appropriate threshold value. Assume virtual Rows and Column by repeating border pixel values.

$$F = \begin{bmatrix} 6 & 5 & 10 \\ 100 & 100 & 100 \\ 4 & 20 & 10 \end{bmatrix}$$

- (c) Assume that edge in the gray level image starts in the first row and ends in the last row. Find the cost of all possible edges using the following cost function. 8

$$\text{Cost}(p, q) = I_{\max} |f(p) - f(q)|$$

Where I_{\max} is the maximum Intensity value in the image and $f(p)$ and $f(q)$ are pixel values at point p and q respectively. Find the edge with minimum value of cost.

Plot the graph $F = \begin{bmatrix} 5 & 6 & 1 \\ 6 & 7 & 0 \\ 7 & 1 & 3 \end{bmatrix}$.

7. (a) How to find Inverse one dimensional DFT using forward DITFFT flowgraph. 20
- (b) Derive High Boost filter mask (3×3).
- (c) Bit reversal technique in FFT.
- (d) Image Enhancement using LOG Transformation and power law transformation.