Character	Frequency
A	5
B	9
C	12
D	13
E	16
F	45

(6)

(b) Write equations with proper notations for two-dimensional Fourier Transformation pair. (4)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4549 **G**

Unique Paper Code : 32347509

Name of the Paper : Digital Image Processing

Name of the Course : **B.Sc. (H) Computer Science (CBCS-LOCF): DSE - II**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A is compulsory. Do any four questions from section B.**

Section- A

1. (a) What is the storage requirement of a 1024 × 1024 gray scale image with 8 gray levels? (3)

(b) What is gamma correction and why is it needed? (3)

(c) For the given 20-byte string, compute the encoded string by using run length encoding. Also, calculate the compression ratio. Assume that integer takes 2 bytes of storage.

SSSSSSSSSTTTTTNGGMMM (3)

(d) Write all the steps involved in frequency domain filtering? (3)

(e) Explain how the Butterworth filter is used for image smoothing and image sharpening. (3)

(f) Define dilation and erosion. Compare both with the help of an example. (4)

(g) List any four methods of image enhancement. Explain how Log transformation helps in image enhancement. (4)

(h) What is the significance of quantization? How does quantization affect gray level resolution in images? (4)

(i) Explain any two sources of image noise. Write the probability density function, mean, and variance for Rayleigh noise. (4)

(iii) *2 x 2* Roberts operator at pixel position *p*.

2	4	7	0	1
3	5	3	4	1
4	0	5 (*p*)	3	1
2	5	0	4	2
1	0	2	2	5

(6)

(b) Define image segmentation. Write the global thresholding algorithm to estimate the threshold value for segmentation. (4)

7. (a) The following table shows six characters occurring in a text with their corresponding frequencies. Each character code takes 1 byte of storage. Construct the variable length Huffman code for the given data. How many bits will be saved if we compress the text using Huffman coding?

Which of these filters is most effective for removing impulse noise? (4)

5. (a) Consider the following binary sub-image *I* of size *5 x 10*. Perform boundary extraction on sub-image *I* using structuring element *B*.

I =

1	1	1	0	1	1	1	1	1	0
1	1	1	0	1	1	1	1	1	0
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1

B =

1	1	1
1	(1)	1
1	1	1

(6)

(b) Discuss Discrete Cosine Transform (DCT) with the help of mathematical expression and write various properties of DCT. (4)

6. (a) Consider a 3-bit sub-image of size 5 x 5. Perform the following operations on the given sub- image:

(i) *3 x 3* Prewitt gradient operator at pixel position *p*.

(ii) *3 x 3* Sobel operator at pixel position *p*.

(j) What is a digital image? Write any four types of digital image formats? (4)

Section- B

2. (a) (i) Explain how *4*-, *8*-, and *m*- paths are computed.

(ii) Consider the following sub-image:

3	2	1	1(***q***)
0	2	0	2
1	2	1	1
1(***p***)	0	1	2

Let $V = \{0, 1\}$. Compute the length of shortest of *4*-, *8*-, and *m*-paths between *p* and *q*. If a particular path does not exist between these two points, explain why? (3+3)

(b) Compute Euclidean distance and Chessboard distance between the pixels *p* and *q* on the following sub-image:

3	1	1	1(*q*)
2	2	0	1
0	3	0	3
1(*p*)	0	1	1

(4)

3. (a) Calculate the first-order and second-order derivatives for the given I-D signal. How many zero crossings are present in the second-order derivative? (6)

6	6	4	3	2	1	0	0	0	6	0	0	0	1	3	1	0	0	0	8	8	8	8

(b) Briefly explain one filter each in spatial and frequency domain to sharpen an image. (4)

4. (a) Consider the following 5-bit sub-image:

0	10	5	2	4	2
1	2	3	2	3	4
5	2	3	2	3	2
3	4	3	4	3	4
2	3	5	2	2	3
1	2	0	7	2	5

Plot the histogram of the above image. What does this histogram say about the type of the image? Improve the contrast of the above image using histogram equalization. (6)

(b) Consider the following 3-bit sub-image of size *5 x 5*:

0	1	0	2	7
2	7	7	4	0
5	6	4 (*p*)	3	3
1	1	0	7	5
5	4	2	2	5

Apply the following 3 x 3 order statistics filters on the center pixel p of the above sub-image (assume zero padding):

(i) Median

(ii) Min

(iii) Max