DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
University of Rajshahi
B.Sc. Engineering Part IV Odd Semester Examination-2021
Course Code: CSE4181 Course Title: Digital Image Processing

Time: 03 Hours Full Marks: 52.50

SECTION A
[ANSWER ANY THREE OF THE FOLLOWINGS]

1.(a) How digital image is represented? Illustrate the key stages of digital image processing system. [3.00]
ch-1 pg-43

(b) You have an image of size 380x260. How much memory is required to store in (i) B/W (ii) grayscale with 48 gray levels (iii) color image with 4 bits quantization. [2.75]

(c) Define spatial resolution. How much resolution is required for an image? Explain with example. [3.00]

2.(a) What is histogram equalization? Is histogram equalization a linear system? [1.75]

(b) Consider the following 5x5 image segment having the gray level scale between [0,7]. Evaluate the histogram equalized image. Also draw the image histogram before and after equalization. [4.00]

4	4	4	4	4
3	4	5	4	3
3	5	6	5	3
3	4	5	4	3
4	4	4	4	4

(c) Distinguish between image sampling and quantization. [3.00]

3.(a) Explain the general model of spatial domain image enhancement. How it can be deduced to point processing operation. [3.00]
pg-122

(b) Define power law transformation. Compare it with linear intensity transformation. [3.00]
pg-127

(c) Explain piece-wise linear transformation and mention its applications. [2.75]

4.(a) Define neighborhood operations with example. Illustrate some simple neighborhood operations. [3.00]

(b) Explain image filtering method using weighted spatial filter and mention its applications. [3.00]
book-151 ch-3 - smoothing spatial filtering

(c) How the problem with edge pixels is resolved during spatial filtering? Explain. [2.75]
RU lec5 pg- 25

SECTION B
[ANSWER ANY THREE OF THE FOLLOWINGS]

5.(a) Differentiate between smoothing and sharpening filters. Sometimes sharpening filter is applied after smoothing filter. Why? [3.00]

(b) Explain the expression $g(x,y) = f(x,y) - \nabla^2 f$ in terms of image enhancement. Derive the spatial mask corresponding to the expression. [3.00]

(c) Mention the steps of frequency domain image filtering. Compare spatial and frequency domain filtering. [2.75]

ch-4

6.(a) Compare Ideal and Gaussian low pass filter with their characteristics curves and mathematical expressions. [3.00]

(b) Define image restoration process. Suppose you have an image with gray levels. Illustrate its histograms after adding Gaussian and exponential noises. [3.00]

(c) How the proper detection of noise model enhances the image restoration? Explain Alpha-Trimmed mean filter. [2.75]

7.(a) Explain the terms Hue and saturation of a color image. [2.00]

(b) Describe the procedures to convert colors from RGB to HSI and HSI to RGB. [5.00]

(c) Explain the color components of a color image with figure. [1.75]

8.(a) Define structuring element, erosion and dilation with examples. [3.00]

(b) Define opening operation and explain boundary detection method using morphological image processing. [2.75]

(c) Explain the method to calculate entropy of an image. Compare lossy and lossless compression. [3.00]

University of Rajshahi

Department of Computer Science and Engineering

BSc Engineering in Computer Science and Engineering 2020

4th year Odd Semester Examination

Course: CSE4181 (Digital Image Processing)

Full mark: 52.5 Time: 3 hours

Answer six questions taking any three from each section

Section-A

1. (a) Define the terms: discrete image, contrast, dynamic range. 3
   (b) Discuss how sampling and quantization affects the quality of digital image. 2-6 3
   (c) How digital image is represented? The amount of light reflected from any object represents its intensity – explain. 2.75

2. (a) There are three levels between image processing and computer vision – illustrate with examples. 1-9 3
   (b) What is resolution of an image? Explain spatial resolution and intensity level resolution. 2-14,22 3
   (c) Define histogram of an image. What type of information of image is represented by histogram? 2.75

3. (a) Consider a 4x4 image segment having the gray scale between [0, 9]. Find the histogram equalized image and draw the image histogram before and after equalization. 3.75

   1 3 2 2
   4 2 4 1
   3 3 4 5
   2 1 3 6

   (b) Define image enhancement and compare its two broad categories. 3-4,9 3
   (c) Illustrate the application logarithmic transformation with suitable example. 4-11 2

4. (a) Discuss how point processing works for image enhancement. 4-4 2.75
   (b) Why log transform is used in image enhancement? Explain with proper example. 4-11 3.25
   (c) Suppose you have an image of landscape and you would like to increase the intensity of specific gray levels. Which transformation is required? Explain. 3-10 2.75

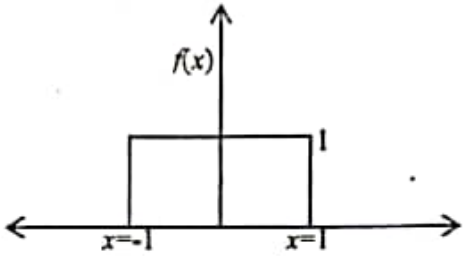
Section-B

5. (a) Mention the general model of spatial filtering for image enhancement. Discuss the effects of mask size in spatial filtering. 3
   (b) Define cross convolution and autocorrelation with example. Mention the applications of autocorrelation. 2.75
   (c) Why edge detection is necessary? Explain thresholding based image enhancement. 3

2021 5-b 1st part

6. (a) Illustrate the application of sharpening filter in image enhancement. Formulate Laplacian mask using derivative filter. 6-12 3

(b) Compare frequency domain filtering with spatial domain. Illustrate the Fourier transform of the following function: 3



(c) Explain the limitations of ideal sharpening filter. How it can be resolved? 2.75

7. (a) Why image segmentation is necessary? Illustrate the process of detecting horizontal and vertical lines in an image with appropriate mask. 3.75

(b) Explain the basic global thresholding method for image segmentation. 3

(c) Explain the model of noisy image. 2

8. (a) Explain derivative based edge detection. It does work properly for noisy image - why? 3.75

(b) Illustrate boundary extraction method in morphological image processing. 2

(c) Define hit, fit and structuring element with examples 3

University of Rajshahi
Department of Computer Science and Engineering
B.Sc.(Engg.), Part-IV, Odd semester Examination, 2019
Course: CSE4181 (Digital Image Processing)

Time: 03 hours **Full marks: 52.50**

Answer six questions taking any three questions from each section

Section-A

1. a) Define image, discrete image and digital image. Explain the main objectives of digital image processing with examples. 4
   b) Explain different processing levels from image to computer vision with examples. 3
   c) Suppose you have a color image of size 512x512. How much memory is required to store the image with opacity? 1.75

2. a) Illustrate the method of digital image representation. Mention the advantages of digital image over analogue. 3
   b) Explain spatial resolution and intensity level resolution with examples. How much resolution is enough for any specific image? 3
   c) Define non-linear quantization. For what type of image it is suitable? 2.75

3. a) What is image enhancement? Explain the objectives of image enhancement. 2.75
   b) Define histogram. Discuss how histogram equalization performs image enhancement. 3
   c) Explain the general model of point processing for image enhancement. 3

4. a) Explain gray level slicing and bit plane slicing. Mention their major application areas. 3
   b) Discuss in detail the Homomorphic and derivative filters. 3
   c) Explain the use of Laplacian operator in edge detection of an image. 2.75

Section -B

5. a) Differentiate between convolution and correlation. The single value threshold usually converts the image into binary image. Suppose you have an 8-bit gray level image of size 256x256. How much memory is required to store it after single value thresholding? 2.75
   b) Explain the effects of mask size for spatial filtering. 3
   c) Define sharpening filter and mention its application in image processing. 3

6. a) What do you mean by full-color and pseudo-color image processing? Derive trichromatic coefficient from tri-stimulus. 3
   b) Discus the model of the image degradation and restoration process. 3.75
   c) Define compression ratio. How are shift codes generated? 2

7. a) Discuss geometric and harmonic mean filter with their application. 3
   b) Explain band reject filter to eliminate periodic noise. 3
   c) Explain the effects of noise in derivative based edge detection. 2.75

8. a) Define morphological image processing. Explain opening method with example. 4
   b) Discuss about basic global thresholding algorithm for image segmentation. 3
   c) Define data redundancy. Illustrate the image compression model. 1.75

University of Rajshahi

Department of Computer Science and Engineering

B.Sc. (Engg.) Part-4, Odd Semester, Examination-2018

Course: CSE4181 (Digital Image Processing)

Marks: 52.5 **Time: 3:00 Hours**

[N.B. Answer any Six questions taking Three from each section]

Section-A

1. (a) Illustrate the image processing system with block diagram. Explain its two most crucial steps. 4
   (b) Why sampling is required? Explain the effects of quantization on the quality of digital image. 3
   (c) State the model of grayscale and color image representation. 1.75

2. (a) Define image histogram. Is it possible to use histogram as feature for image classification? Explain. 3
   (b) How does the histogram of the following image look like: 2
   (i) Dark image, (ii) Bright image, (iii) Low contrast image, (iv) High contrast image
   (c) Explain histogram equalization process for image enhancement with example 3.75

3. (a) How point processing works for image enhancement? Discuss. 2.75
   (b) Why Log transform is used in image enhancement? Explain with proper example. 3
   (c) How negative image is obtained? Explain gray level slicing method. 3

4. (a) What are the different causes of image degradation? 2
   (b) Discuss the model of the image degradation and restoration process. 5
   (c) Mention the drawbacks of inverse filtering. 1.75

Section-B

5. (a) Why image sharpening filter is required for image enhancement? Explain. 3
   (b) Write down the steps of frequency domain image filtering. Compare it with spatial filtering. 3
   (c) Explain the problem of using ideal low pass filter. Explain the equation $H_{hp}(u, v) = 1 - H_{lp}(u, v)$. 2.75

6. (a) Mention the sources of noise. Explain the model of noisy image. 3
   (b) Discuss the method of suppressing periodic noise from the image. 3
   (c) Explain Geometric mean and midpoint filter to remove noise. 2.75

7. (a) Define image segmentation with example. Illustrate the process of detecting horizontal and vertical lines in an image with appropriate mask. 3.75
   (b) Explain the method of thresholding for image segmentation. 2
   (c) Explain how histogram is used in image thresholding. 3

8. (a) Define compression ratio. How are the shift codes generated? 3
   (b) State the principle of Huffman coding. 4
   (c) Mention the limitation of Huffman coding. 1.75

University of Rajshahi

Department of Computer Science and Engineering

B.Sc. (Engg.) Part-IV, Odd Semester, Examination 2017

CSE4181 (Digital Image Processing)

Marks: 52.5 Time: 3 Hours

Answer any **three** questions from **each part.**

Part-A

1.(a) Illustrate the mathematical model to represent gray-scale and color image. 2

(b) Define non-uniform sampling. Explain the effects of sampling and quantization on the quality of digital image. 4

(c) Differentiate between gray-scale and B/W image. Suppose you have a color in which the maximum intensity levels of Red, Green and Blue colors are 25, 26 and 27 respectively. How much memory is required to store the image of size 200 × 200. 2.75

2.(a) Define histogram and illustrate its applications in image understanding. 3

(b) Explain the process of histogram equalization in image enhancement. Differentiate between histogram equalization and histogram specification methods for image enhancement. 3

(c) Perform histogram equalization of 5x5 image having the following data: 2.75

Gray level	0	1	2	3	4	5	6	7
No. of pixels	0	0	0	8	~~12~~ 11	6	0	0

3.(a) Is it possible to reduce the noise contents by adding a set of noisy images? Justify your answer. 3.75

(b) Assume that the fingerprint shown in the following Figure-3(a) is corrupted by noise. Write down the steps to eliminate the noise and its effects on the fingerprint while distorting it as little as possible so that we can get an image as shown in the following Figure-3(b). 5

(a) (b)

Figure-3

4.(a) Mention the effects of power law transformation. Explain the outcomes of power law transformation with $\gamma = 3$ and $\gamma = 0.3$ in general equation, $s = c * r^{\gamma}$. 3

(b) Differentiate between point processing and neighbourhood operation for image enhancement in spatial domain. Illustrate the general model of spatial filtering. 2.75

(c) Explain weighted smoothing filter operation with example. 3

Part-B

5.(a) Derive the Laplacian mask using 2nd derivative in spatial domain. 3

(b) Consider the following image with 4-bit gray level and construct the vector x consisting the intensity along the scanning line AB. Then derive the 1st and 2nd derivatives of x. 3

(c) Differentiate between 1st and 2nd derivatives for image sharpening. 2.75

6.	a)	Define Sobel operator. Write Sobel horizontal and vertical edge detection masks.	3.75
	b)	Explain line detection technique.	3
	c)	Define compression ratio. How are shift codes generated?	2
7.		Explain the terms Hue and Saturation for a color image.	2
		Describe the procedures to convert colors from RGB to HSI and HSI to RGB.	5
		Explain the color complements of a color image with figure.	1.75
8.	a)	Define image segmentation and mention its necessity. Explain basic global thresholding method.	4
	b)	Differentiate between single and multi-value thresholding with examples.	1.75
	c)	Write morphological algorithm for (i) Convex Hull, (ii) Thinning and (iii) Thickening.	3

University of Rajshahi

Department of Computer Science and Engineering

B.SC (Engg.) Part-4, Odd Semester, Examination 2016

Course: CSE-4181 (Digital Image Processing)

Time: 3 Hours | Full Marks: 52.5

Section-A

1. a) Define the terms: brightness, contrast, dynamic range. 3
   b) Discuss the model of the image degradation and restoration process. 4
   c) Illustrate the mathematical model for grayscale and binary image representation in terms of incident and reflected light intensity. 1.75

2. a) What is resolution? Explain spatial resolution and intensity level resolution. 2
   b) What type of information of image is represented by histogram? Can it be used image recognition? Explain. 2.75
   c) Obtain histogram equalization for the following image segment of size 5 X 5. Write the interference on the image segment before and after equalization. 4

44444
34543
35553
34543
44444

3. a) Explain gray level slicing and bit plan slicing. Mention their major application areas. 3
   b) Discuss in detail the Homomorphic and derivative filters. 3
   c) Suppose you have an x-ray image. How its intelligibility can be increased? Explain. 2.75

4. a) Illustrate the general model of spatial filtering for image enhancement. Is there any relationship between the spatial resolution and the size of the mask? Explain. 3
   b) Define cross correlation and autocorrelation with example. Mention the uses of autocorrelation. 2.75
   c) When edge detection is necessary? Explain how image enhancement is performed using histogram based thresholding. 3

Section-B

5. a) Explain point processing and neighborhood operations for image enhancement. How are they related? 3
   b) Consider the following image and draw the signal representing the gray level values along the scanning line AB. Then illustrate the Fourier transform of the signal. 2.75

   c) How frequency domain image filtering is implemented? Explain ideal filter for image sharpening. 3

6.(a) Assume a 4-bit 6×6 image, $f(x,y)$, has the following matrix of intensity.

15	5	15	15	5	6
6	15	2	2	14	4
5	15	2	2	12	2
4	15	4	4	10	1
3	15	3	4	15	0
2	2	15	15	0	0

What are the 1st, 2nd, 3rd and 4th bit planes of $f(x,y)$? What kind of information do the higher-order and lower-order bit planes contain? 3

(b) What will be the output image (intensity matrix), $g(x,y)$, after applying transformation function $T(r)$ as shown in Figure-6(a) and Figure-6(b) on $f(x,y)$ [intensity matrix shown in question 6(a)].

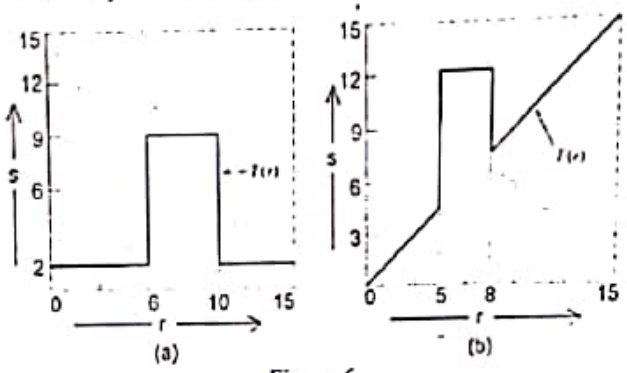


Figure-6

Here r and s denote gray levels of $f(x,y)$ and $g(x,y)$, respectively.

7.(a) Associate each histogram shown in Figure-7[d-f] with an Image shown in Figure-7[a-c]. 1.5

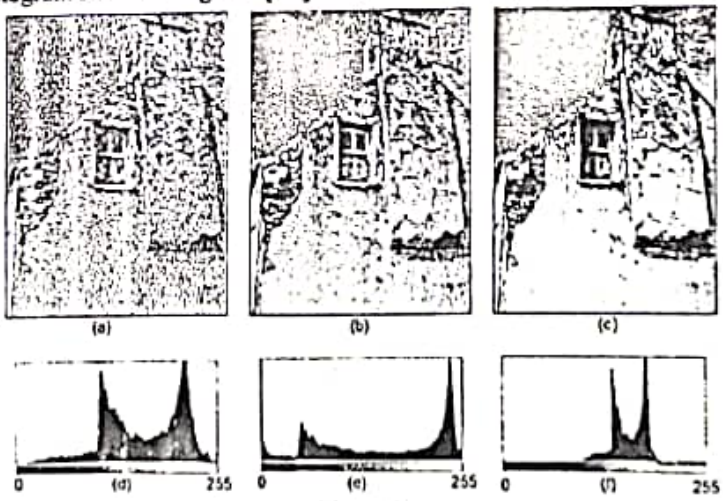


Figure-7

(b) Write down the steps to get the image in Figure-7(c) from the image in Figure-7(a). 5

(c) Can we reconstruct any image from its histogram? Justify your answer. 2.25

8.(a) Illustrate the applications of morphological operations in image processing with examples. 3

(b) Explain opening operation with examples. 3

(c) Define hit, fit and structuring element. Explain the effects of structuring element in erosion. 2.75