

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Fall 2021

Year: 4<sup>th</sup> Semester: 2<sup>nd</sup>

Course Number: CSE4227

Course Name: Digital Image Processing

Time: 3 (Three) hours

Full Marks: 70

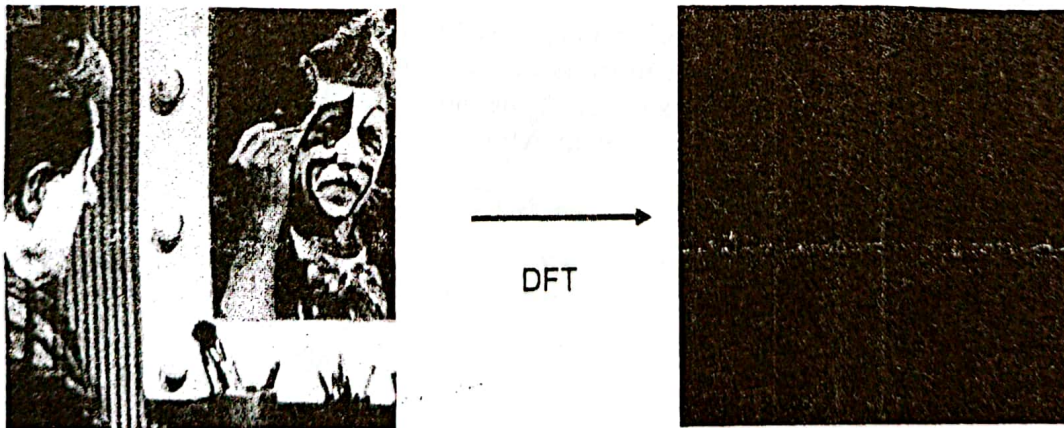
Use separate answer script for each part

Part A

[There are 03 (three) questions carrying a total of 14 marks each. Answer any 02 (two) questions. Marks allotted are indicated in the right margin.]

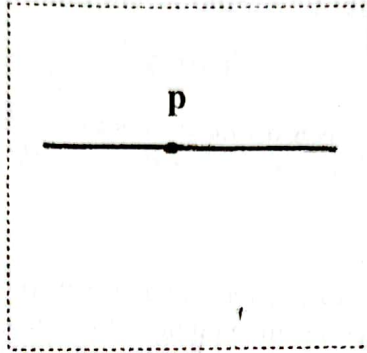
Question 1. [Marks: 14]

- a) Suppose you have taken a photo of your grandmother. In that photo, you noticed some wrinkles on your grandmother's skin. You need to reduce the wrinkles from the photo with no ringing effect. Which frequency domain filter will you use? Mention the filter name and justify your answer. Also, define the filter function  $H(u, v)$  in the frequency domain with appropriate figures. Besides, describe the reason for the ringing effect. [8]
- b) Describe the basic steps for filtering in the frequency domain. Explain why the maximum frequency of spatial domain is 0.5. Consider the following image with its DFT. Only DC value is visible in the spectrum. Explain why? Also, discuss the solution of this problem. [6]



Question 2. [Marks: 14]

- a) What do you understand by image segmentation? How many steps are in Canny Edge Detection Algorithm and what are the steps? Explain the step Non Maximum Suppression. What are the false positive and the false negative edge pixels? How canny algorithm reduces these errors? [8]
- b) Consider a set of points  $P(1,4)$ ,  $Q(3,1)$ ,  $R(2,3)$ ,  $S(5,0)$ ,  $T(4,1)$ . Join these points using Hough transform. Is there any problem in the parameter space of the Hough transform algorithm? Justify your answer. Find the value of diameter and the angle from the following line for the point  $p(20, 25)$ . [6]



Question 3. [Marks: 14]

- a) Suppose you have bought an inkjet printer recently. Besides, your father has bought a computer for your birthday gift. Describe the color model used in your computer monitor and printer. Among red, green and blue, which light will appear brightest followed by others? Justify your answer. Also, discuss the two major areas of color image processing. [8]
- b) Consider, AUST.png is a  $256 \times 256$  image where the number of gray levels is 64. Calculate the bit depth and size in bytes of AUST.png. Describe Mach Band effect. What do you understand by index image? "The more intensity level used, the finer level of detail discernible in an image"-explain why? [6]

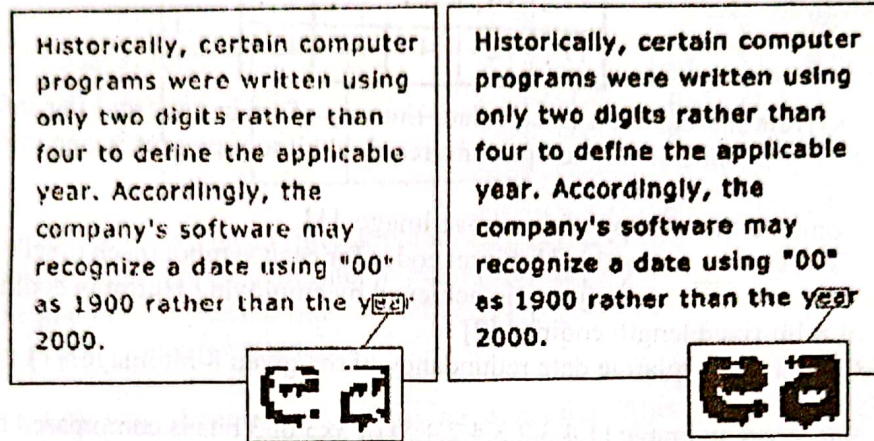


## Part B

[There are 04 (four) questions carrying a total of 14 marks each. Answer any 03 (three) questions. Marks allotted are indicated in the right margin.]

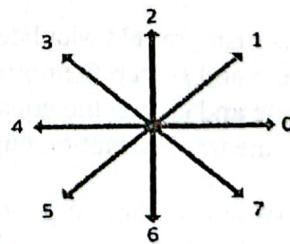
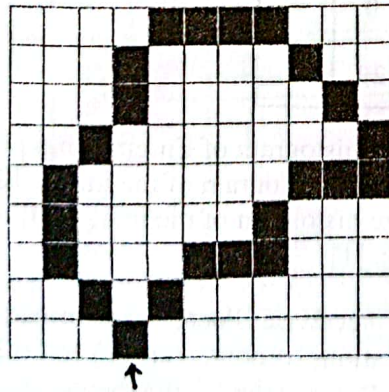
### Question 1. [Marks: 14]

a) Consider the following image. [8]



- Which morphological operation is used to join the broken characters? Explain briefly. [3]
- Define Opening and Closing operations mathematically with their applications. [3]
- Design four Hit-or-Miss transformation SEs for locating four corners from an image. [2]

b) Consider the following boundary (in anticlockwise direction): [6]



- What is Chain Code? Describe the Problems in Chain Code Representation. [3]
  - Compute the Chain Code that is invariant to both starting point and rotation. [3]
- [Use 8-neighbor relationship]

Question 2. [Marks: 14]

- a) Consider the simple 5×5, 8-bit image as in the 2-D array below:

[8]

18.	16.	16.	14.	12.
11.	11.	12.	14.	12.
11.	14.	12.	12.	14.
12.	16.	16.	17.	17.
17.	12.	11.	14.	11.

- Derivate the equation to calculate Entropy of an image from the information theory to understand the optimum required bit to represent image information. [2]
  - Compute the entropy of the above image. [1]
  - Calculate the respective Huffman codes for each symbol (each pixel value). [2]
  - What is the compression ratio achieved by employing Huffman coding instead of 8-bit fixed length coding? [2]
  - Calculate the relative data redundancy of the given 8-bit image. [1]
- b) i. Supposed an image [1,4,3,2,3,4,2,4,5] of 3x3 of 3 bits is compressed by a lossy compression technique; after de-compression, all the pixel values increased by 2. Calculate the Root Mean Square Error as fidelity criteria. [3]
- ii. Compute the Golomb code for  $G_4(9)$ . [3]  $\rightarrow 11001$

Question 3. [Marks: 14]

- a) Consider Enigma.png is a 4x4 image with 5-bit gray values.

[8]

16.	30.	8.	10.
25.	1.	12.	0.
6.	13.	9.	5.
19.	14.	29.	4.

- What is histogram? Calculate the histogram of Enigma.png. [2]
  - Compute and sketch the normalized histogram of the image. [2]
  - Compute and sketch the equalize histogram of the image. [3]
  - Sketch the transformation curve. [1]
- b) Contrast Stretching is one type of piecewise linear transformation function. In piecewise linear transformation the locations of points  $(r_1, s_1)$  and  $(r_2, s_2)$  control the shape of transformation function. Now illustrate the relation between  $(r_1, s_1)$  and  $(r_2, s_2)$  for
- Linear Identity [1]
  - Thresholding [2]
  - Contrast Stretching [3]



Question 4. [Marks: 14]

- a) The following image shows a 3-bit 4x4 image (left) and a Laplacian filter (right). Now, [8]  
Find the followings:

	0	1	2	3
0	7	1	0	5
1	6	3	6	2
2	6	4	4	1
3	1	5	7	0

0	1	0
1	-4	1
0	1	0

- the output of 3x3 mean filter at point (2,2). [2]  $\rightarrow 4$
  - the output of 3x3 median filter at point (0,0). [2]  $\rightarrow 0$
  - the output of Laplacian filter at point (1,1). [2]  $\rightarrow 5, 2$
- [Use zero padding for edge pixels]
- Explain why the output of applying a median filter preserves more edge sharpness in compared to that of applying a mean filter. [2]

- b) Consider the two image subsets S1 and S2 and answer the following questions based [6]  
on these two image subsets.

S1					S2				
0	0	0	3	2	2	1(y)	2	1	2
0	1	0	2	1	1	1	2	2	0
0	0	0	1	1	1	0	2	3	2
0	0	1(x)	0	0	2	2	3	2	2
0	0	1	1	1	0	0	1	1	1

- Draw a digital path from S1 or S2 and explain? [2]
- Does a four path exist between (x) and (y) for  $V = \{1, 2\}$ ? [1]
- Do four path and m-path exists between (x) and (y) for  $V = \{1, 0\}$ ? [2]  
[If your answer is yes, draw the path. If no, explain why.]
- Determine whether S1 and S2 are 4-adjacent for  $V = \{1, 2\}$ ? [1]