

Heaven's Light Is Our Guide
RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY
 DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

4th Year Odd Semester Examination 2019

COURSE NO: CSE 4105 COURSE TITLE: Digital image Processing
 FULL MARKS: 72 TIME: 3 HRS

- N.B. (i) Answer any SIX questions taking any THREE from each section.
 (ii) Figures in the right margin indicate full marks.
 (iii) Use separate answer script for each section.



SECTION : A

Marks

- Q.1. (a) Define the following terms: i) Brightness adaption ii) Simultaneous contrast, iii) Match band and iv) Weber ratio. 4
 (b) What do you mean by isopreference curve? Which purpose(s) we use this curve? Explain it briefly. 4
 (c) Define the following terms: i) 4-adjacency, ii) 8-adjacency, and iii) m-adjacency. What is the advantage of m-adjacency over 8-adjacency? 4
- Q.2. (a) Define image segmentation. Discuss region oriented segmentation in details. 4
 (b) Differentiate between image enhancement and image restoration. Draw different types of noise models usually present in the image. 4
 (c) Define pixel relationship. How to find the connection path (mixed) for a digital image. Find out the shortest 4-path, 3-path, and m-path between pixels p and q shown in the following image. 4

4	2	3	2(q)	$V = \{1, 2\}$
3	3	1	3	
2	3	2	2	
(p)2	1	2	3	

- Q.3. (a) Write down the equation of convolution and correlation of $w(x,y)$ and $f(x,y)$ where $f(x)$ represents an image and $w(x,y)$ represents a filter of size $m \times n$. Explain - "median filter is a non-linear filter". 6
 (b) We know that the principal objective of sharpening is to highlight transitions in intensity of an image. Your task is to design a Laplacian and a gradient filter and describe the effect of these filters on an image. 4
 (c) Write down the steps of unsharp masking. 2
- Q.4. (a) Briefly explain spatial filtering for image enhancement when a mean filter is used. 4
 (b) For the task of spatial filtering describe the i) correlation and ii) convolution process. 4
 (c) Define bit plane slicing. Find out the bit plane of the following 3×3 image. 4

1	2	3
4	5	0
7	2	1

SECTION : B

- Q.5. (a) Write down the general form of $H(u,v)$ in frequency domain for i) ideal lowpass filter ii) Butterworth lowpass filter and iii) Gaussian lowpass filter. Why do we use lowpass filter on image? 4
 (b) How do you apply homomorphic filter on an image? Why we use this filter? 4
 (c) Explain briefly about bandpass and notch filter in frequency domain. 4
- Q.6. (a) How do you measure image information? Explain briefly. 4
 (b) Let, we have an image: 4

A_1	A_5	A_2
A_2	A_1	A_3
A_4	A_3	A_1

Let each symbol is represented by 8 bits. Compress this image using Huffman coding and find the compression ratio.

- (c) What is binary code and gray code? What will be the difference occurred if we use gray code instead of binary code to compress the following image using bit plane coding. 4

10	7	8	9
11	8	7	6
9	7	5	4
10	11	2	1

- Q.7. (a) Explain the following expression and summarize it to a simplest form in terms of morphological image processing. 4

Expression: $\{((A \cdot B) \oplus B) \ominus B\}$

- (b) Define image redundancy. Find out the redundancy R_0 if the size of the original image is 3KB and size of the compressed image is 1KB. 4

- (c) Find the 2nd order entropy of the following digital image: 4

20	20	20	90	90	245	245	170
20	20	20	90	90	245	245	170
20	20	20	90	90	245	245	170
20	20	20	90	90	245	245	170

- Q.8. (a) Describe histogram matching. Perform the histogram specification to obtain the desired image from the following original image. 5

Original image:

Grey Level	0	1	2	3	4	5	6	7
No. of Pixel	2	10	10	2	12	16	4	2

Desired image:

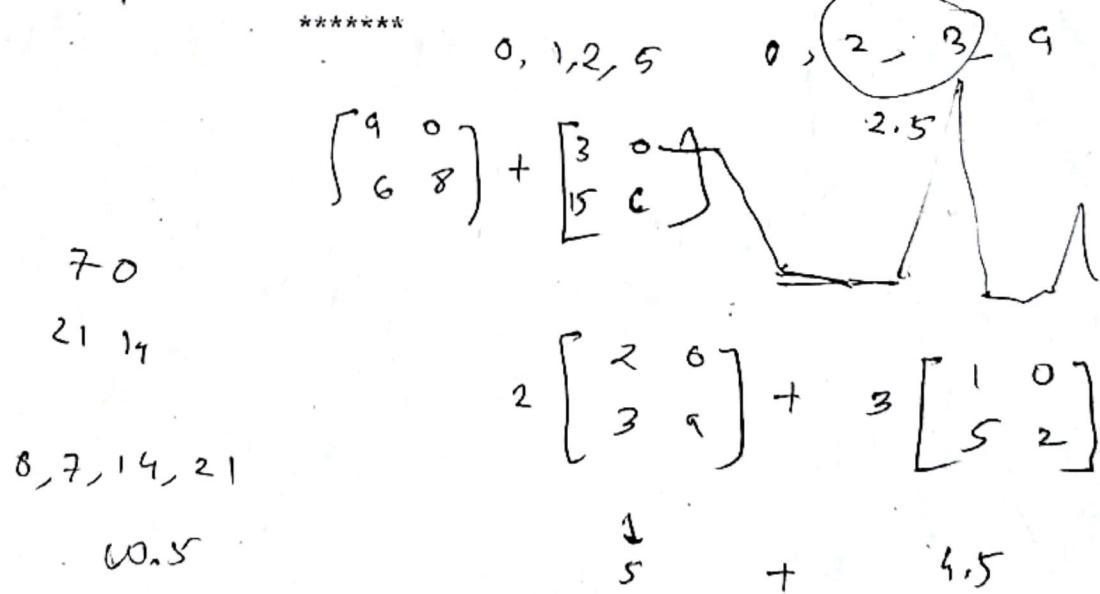
Grey Level	0	1	2	3	4	5	6	7
No. of Pixel	0	0	0	0	20	20	16	8

- (b) Derive the Laplacian mask using 4-neighbors. Simplify the mask and show your resultant mask. 4

- (c) Consider the image strip: 3

5	5	4	3	2	1	0	0	0	6	0	0	2	3
---	---	---	---	---	---	---	---	---	---	---	---	---	---

Summarize the responses comparing between first and second order derivative of the strip.



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4th Year Odd Semester Examination 2018

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FULL MARKS: 72 TIME: 3 HRS

- N.B. (i) Answer any SIX questions taking any THREE from each section.
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(iii) Use separate answer script for each section.

SECTION : A

- Q.1.** (a) Suppose, you have a continuous image defined as $f: R^2 \rightarrow R, f(x, y)$. How do you convert this continuous image to digital image? Explain with an example. 4
(b) Describe contrast stretching. What effect does it have on image histogram? 4
(c) Consider the two image subsets, S_1 and S_2 shown in the following figure. For $V=\{1\}$ determine whether these two subsets are (a) 4-adjacent (b) 8-adjacent, or (c) m-adjacent. 4

S_1	S_2
0 0 0 0 0 ;	0 0 1 1 0
1 0 0 1 0 ;	0 1 0 0 1
1 0 0 1 0 ;	1 1 0 0 0
0 0 1 1 1 ;	0 0 0 0 0
0 0 1 1 1 ;	0 0 1 1 1

- Q.2.** (a) What is median filtering? How it can be used to remove salt-and-pepper noise? 3
(b) Suppose we have 3 bits, 64x64 digital image. Let the histogram of the digital image is given (see fig. a.). You generate a processed image that has a specified histogram (see fig. b.) using histogram matching technique. 6

r_k	$P_r(r_k) = \frac{n_k}{mN}$
0	0.19
1	0.25
2	0.21
3	0.16
4	0.08
5	0.06
6	0.03
7	0.02

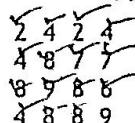
fig. a.

Z_q	Specified $P_s(Z_q)$
0	0.00
1	0.00
2	0.00
3	0.15
4	0.20
5	0.30
6	0.20
7	0.15

fig. b.

- (c) Explain why averaging N noisy images work as a de-noising step? When can this procedure fail? 3

- Q.3.** (a) What is entropy estimation? Find out the entropy estimation of the following image. 4



- (b) We have an 3x3 Laplacian filter mask (see fig. a.). How do we design such kind of mask? Explain the effect when we apply this mask on an image. 6

0	1	0
1	-4	1
0	1	0

fig. (a)

- (c) What are the differences between inter pixel redundancy and psycho-visual redundancy? 2

- Q.4.** (a) What will be happened if we perform histogram equalization on the histogram equalized image? 3
(b) Describe a scenario where, local histogram processing works better than global histogram processing/equalization. 3
(c) Consider the image segment shown below. Let $V=\{1,2\}$, compute the lengths of the shortest 4, 8, and m-path between pixel (p) and (q). If a particular path does not exist between p, q, explain, why? 6

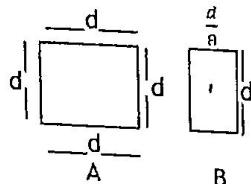
3	1	2	1(q)
2	2	0	2
1	2	1	1
(p)1	0	1	0

SECTION : B

- Q.5. (a) Why do we use homomorphic filtering technique? Explain mathematically how we apply this technique on an image? 4
 (b) In a given text file, the characters are distributed with the probabilities, $\{(A, 0.3), (B, 0.1), (M, 0.4), (R, 0.06), (W, 0.04), (Z, 0.1)\}$. Find out the Huffman code, source entropy and efficiency. 4
 (c) Explain the different stages of the JPEG compression technique. 4
- Q.6. (a) Apply the bit plane coding on the following image: 4

8	8	7
8	8	7
8	8	7
8	8	7

- (b) Find the compression ratio.
 Consider the set A and structuring element B, now find out the (i) Dilation (ii) Erosion of A with respect to B. 4



- Q.7. (c) Write the steps to construct Golomb coding, $G_m(n)$. Find the Golomb coding for $m=7$ and $n=36$. 4
 (a) Why high-boost filtering is necessary for image processing? What are the advantages of high-boost filtering over high-pass filtering? Explain. 4
 (b) Consider a two hours Standard Definition (SD) television movie using $720 \times 500 \times 24$ bit pixel arrays. If the transmission rate is 30fps, how many GB of memory is required to store the movie? 4
 (c) Write down the three fundamental steps performed in edge detection. 4
- Q.8. (a) Explain how the following operations are performed by morphological processing:
 (i) Boundary extraction (ii) Hole filling and (iii) border clearing. 4
 (b) Define bit plane slicing. Describe the process of bit plane slicing with an appropriate example. 4
 (c) Explain the effect of image derivation on (i) ramp (ii) step (iii) isolated point and (iv) thin line 4

N.B. Answer six questions, taking three from each section.
 The questions are of equal value.
 Use separate answer script for each section.

SECTION-A

Q1. (a) Describe the basic intensity transformation function given below: 4

i) $S = L - I - r$

ii) $S = c \log(1+r)$

iii) $S = Cr^2$

(b) Explain the basic concept of sampling and quantization method in digital image processing. 4

(c) How does the histogram of a blur image look like? Describe the effect of contrast stretching on the histogram. 4

Q2. (a) Define the spatial and intensity resolution with proper example. 2

(b) We know about three types of interpolation methods named nearest neighbor interpolation, bilinear interpolation, and cubic interpolation. Which technique do you prefer? Justify your answer. 4

(c) What do you mean by 4-adjacency, 8-adjacency and m-adjacency? Consider the two image subsets S_1 and S_2 shown in the following figure. For $V=\{1\}$, determine whether these two subsets are (a) 4-adjacent, (b) 8-adjacent or (c) m-adjacent. 6

	S_1				S_2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

Q3 (a) Show that, sum operator is a linear operator. 3

(b) What do you mean by point processing and neighborhood processing technique? Define a spatial filter. 3

(c) Which spatial transformation method maps a narrow range of dark input values into a wider range of output values, with the opposite being true for higher values of input levels? Explain briefly. 4

(d) Explain the piecewise-linear transformation technique Bit-plane slicing. 2

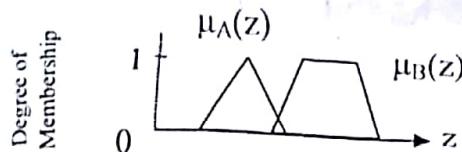
Q4. (a) Suppose that a 3 bit image of size 64×64 pixel has the intensity distribution shown in the following table where the intensity level are integers in the range [0-7]. Apply the histogram equalization technique on this image and find the equalized histogram. 4

r_k	n_k
$r_0=0$	790
$r_1=1$	1023
$r_2=2$	850
$r_3=3$	656
$r_4=4$	329
$r_5=5$	245
$r_6=6$	122
$r_7=7$	81

(b) What are the effects of first order and second order derivative on a horizontal intensity profile from an image? 4

(c) Derive the sharpening spatial filter, Laplace operator. Explain the four major variations of Laplace operator. 4

Q5. (a) Membership function of two sets A and B are given



Find the complement of A, the union and intersection of the two sets.

(b) Segment the object by region growing where the seed for the object is underlined and 5 region grows horizontally and vertically. Apply 8 connectivity, 4 connectivity and consider the condition that difference between 2 pixel values is less than or equal to 2(two).

20	21	21	20	21	21
20	20	51	20	22	20
20	52	<u>50</u>	52	53	50
20	51	50	51	50	51
21	50	51	53	50	20
21	20	20	21	21	21

(c) Describe the following process with example:

- i) $(B)_z = \{C | C = b + z, \text{ for } b \in B\}$
- ii) $A \ominus B = \{Z | (B)_z \subseteq A\}$
- iii) $A \oplus B = \{Z | (\bar{B})_z \cap A \neq \emptyset\}$

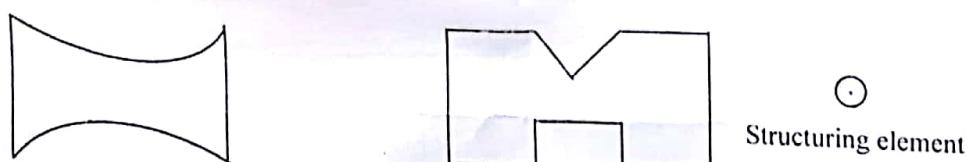
Q6. (a) Describe the following frequency domain filter: i) ideal lowpass filter, ii) Butterworth 6 lowpass filter, iii) Gaussian lowpass filter.

(b) By hand, sketch the horizontal profile of gradient magnitude for the following image signal 3



(c) Describe the fundamental steps performed in edge detection.

Q7. (a) Explain the opening and closing operation on both objects given below with the structuring element.



(b) Explain the sentence- "Erosion is the dilation of the background".

(c) Explain how the following operation are performed by morphological processing,

- i) Hole filling.
- ii) Border clearing.

Q8. (a) Find out the compression ratio and the redundancy level for the encoding approaches- i) Run length, ii) DPCM, and iii) Huffman when applied to the following data set:

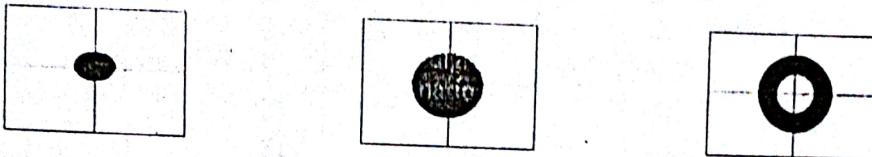
AAAAAABBBBAAAAAAABBAAAAACCCCBBBBCCBBBD

(b) Prove that, convolution in spatial domain is analogous to multiplication in the frequency domain.

(c) Describe the steps of filtering in frequency domain.

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SECTION : A

- Q.1.**
- (a) What is the effect of quantization on digitization of an image? 2
 - (b) Describe the basic intensity transformation function given below, $4\frac{1}{2}$
 - i) $S = I - 1 - r$
 - ii) $S = c \log(1 + r)$
 - iii) $S = cr^2$
 - (c) How does the histogram of a blur image look like? Describe the effect of contrast stretching on the histogram. $2\frac{1}{2}$
 - (d) Differentiate the following methods with respect to re-sampling, $2\frac{2}{3}$
 - i) Nearest neighbor interpolation
 - ii) Bicubic interpolation
- Q.2.**
- (a) Describe histogram processing. How does the histogram of a bright, dark, low contrast and high contrast image look like? 3
 - (b) Draw the histogram of the corresponding spatial image of the following Fourier image, 3
- 
- (e) Why image alignment is required before performing subtraction based change detection? 3
- (d) What is a median filtering? How it can be used to remove salt-and-pepper noise? $2\frac{2}{3}$
- Q.3.**
- (a) Explain why averaging N noisy images work as a de-noising step? When can this procedure fail? $4\frac{2}{3}$
 - (b) Discuss about the RGB, CMYK, YUV AND L*a*b color spaces. 4
 - (c) What are the effects of first order and second order derivative on a horizontal intensity profile from an image? 3
- Q.4.**
- (a) Explain how does the Principle Component Analysis (PCA) work for face recognition problem? $4\frac{2}{3}$
 - (b) What do you mean by energy compaction property of linear transformation? 3
 - (c) Explain why the discrete cosine transformation (DCT) is used rather than the Karhunen-Loéve Transformation (KLT) for image compression. 4

SECTION : B

- Q.5.**
- (a) How does the Otsu's thresholding based image segmentation work? Describe a strategy to find this threshold. 5
 - (b) Why a global threshold does not work for all images? How can this problem be solved? $2\frac{2}{3}$
 - (c) Explain the region labeling algorithm. Apply it on the following image. 4

3				1	
				1	
		2	2	2	
		2		2	
3	3	3	3	3	

- Q.6.**
- (a) Describe the following process with examples, 4
 - i) $\hat{B} = \{w | w = -b, \text{ for } b \in B\}$
 - ii) $(B)_z = \{c | c = b + z, \text{ for } b \in B\}$
 - iii) $A \ominus B = \{z | (B)_z \subseteq A\}$
 - iv) $A \oplus B = \{z | (\hat{B})_z \cap A \neq \emptyset\}$

- (b) Explain how the following operations are performed by morphological processing,
 i) boundary extraction , ii) hole filling iii) border clearing
 (c) Design a closing filter to remove small holes from a binary image.

3
2
4

- Q.7.** (a) Design filters that performs the following tasks:
 (i) image sub-sampling 4:1 horizontally and vertically
 (ii) sub-sampling by averaging
 (iii) sub-sampling by averaging of two horizontal or vertical neighbor pixels. 5 $\frac{2}{3}$
 (b) What is ringing effect due to hard frequency filtering? 2
 (c) Discuss about the unsharp masking effect of photoshop. 4
- Q.8.** (a) Justify the use of DWT instead of DCT in JPEG 2000. 2 $\frac{2}{3}$
 (b) Use the region growing idea to segment the object. The seed for the object is the center of the image. Region is grown in horizontal and vertical direction, and when the difference between two pixel values is less than or equal to 5. [Find the results for both 4-connectivity and 8-connectivity] 6

10	10	10	10	10	10	10
10	10	10	69	70	10	10
59	10	60	64	59	56	60
10	59	10	60	70	10	62
10	60	59	65	67	10	65
10	10	10	10	10	10	10
10	10	10	10	10	10	10

- (c) Describe the stages of k-means clustering process for segmentation. 3

N.B.

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SECTION A

Q1(a) Design a lowpass filter in frequency domain. Explain its spatial domain counterpart. 02½

(b) Explain the process of edge detection based on the following images. 02½

(c) Describe the whole unsharp masking process. 03

(d) What can you infer from the following frequency response images? 03



Q2(a) Explain how a noisy image can be denoised using image averaging operation? 03

(b) Explain what happens to the images if the following arithmetic operation is performed: 03

(i) Addition, (ii) Subtraction, (iii) Averaging, (iv) AND, (v) OR

(c) What is the necessary transformation that will expand the bright dynamic range? Explain. 02½

(d) How the histogram of a dark, bright, low contrast and high contrast image look like? 03

Q3(a) Explain, with example, the advantages of locally adaptive thresholding over global thresholding. 04

(b) What is a median filter? How median filtering can be used to remove salt-and-pepper noise. 03

(c) What is an integral image? How can it be used to implement a Gaussian filter? 04

Q4(a) What is ringing problem? How can you remove it? 03

(b) In which cases order statistic or nonlinear filters are used? Explain with example. 03

(c) What is a scale-space representation of an image? Write short notes on: 03

(i) Laplacian of Gaussian (LoG) and (ii) Difference of Gaussian (DoG)

(d) Explain the significance of fourier transformation in filtering. 02½

SECTION B

Q5(a) Explain 3 approaches for edge linking to detect boundary. 03½

(b) How can you remove double line effect resulted from laplacian mask? 03

(c) Segment the object by region growing approach where the seed for the object is underlined and region grows in horizontal and vertical directions. Apply 8-connectivity and consider the condition that difference between 2 pixel values is less than or equal to 2 (two). 05

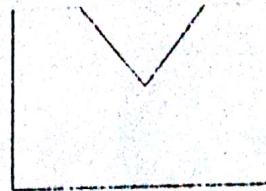
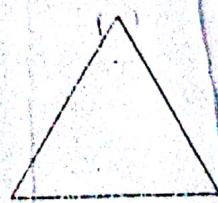
20	21	21	20	21	21
20	20	51	20	22	20
20	52	50	52	53	50
20	51	50	51	50	51
21	50	51	53	50	20
21	20	20	21	21	21

Q6(a) Explain the effect of image derivative on 02½

i) ramp, ii) step, iii) isolated point, and iv) thin line

(b) Explain the significance of derivatives in edge detection with examples. 03½

(c) Below are the two objects and a structuring element. Explain opening and closing on both of the objects with the structuring element. 05½



Structuring element

Q7(a) Explain the sentence—"Erosion is dilation of the background". 03

(b) How can you perform image recognition using erosion operation? 04½

(c) What is an Eigen-image? How can you generate Eigen-images from an image data set? 04

Q8(a) Briefly explain the stages of JPEG compression techniques. 06½

N.B:

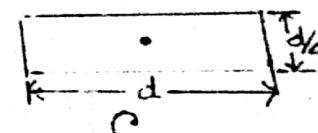
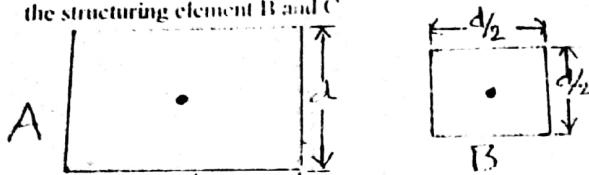
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SECTION A

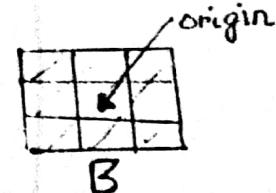
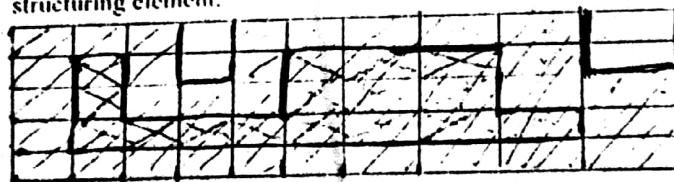
- | Q.1(a) | Marks |
|--|-------|
| Describe the method by which you can convert colors from HIS to RGB. | 03 |
| (b) Write an algorithm for determining the mean of an image from a histogram. | 03 |
| (c) What is contrast stretching? What effect does it have on image histogram? | 03 |
| (d) "Image is a function", explain. | 02 |
| (e) What is histogram? Draw the histogram of the following types of image. | 04 |
| (i) Dark image (ii) Bright image (iii) Low-contrast image and (iv) High contrast image. | 04 |
| (f) What is segmentation? Discuss region oriented segmentation in details. | 04 |
| (g) Write down the pseudo code of converting a color image to its corresponding gray level image. | 03 |
| Q.3(a) | 04 |
| What kind of operation do we perform to map a narrow range of low gray-level input image into a wider range of output levels and why? | 04 |
| (b) The sum of all elements in the mask of the smoothing averaging spatial filtering must be equal to what and why? <i>The constant multiplier in front of each mask</i> | 02 |
| (c) Explain the significance of Fourier transformation in image filtering. | 03 |
| (d) What is an edge of an image? | 02 |
| Q.4(a) | 03 |
| Can we find the edges of an image with help of average filter masking? If not, design a filter to find the edges of an image. | 03 |
| (b) Differentiate between m-adjacency and 8-adjacency. | 03 |
| (c) Design a low pass filter in the spatial domain. | 03 |
| (d) What is ringing problem? | 02 |

SECTION B

- | | |
|--|----|
| Q.5(a) | 04 |
| Discuss the block diagram of image compression. Differentiate the data and information. | 04 |
| (b) | 03 |
| What is a Fidelity criterion? Discuss the subjective and objective Fidelity criteria in brief. | 03 |
| (c) | 03 |
| Give example of three types of lossless and three types of lossy compression. | 03 |
| Q.6(a) | 03 |
| What is morphology? Write down the application of it. | 03 |
| (b) | 04 |
| Describe Dilation and Erosion mathematically. Apply the Dilation and Erosion on image A using the structuring element B and C. | 04 |



- (a) Write down the equation of boundary extraction. Find out the boundary of A by using B as structuring element.



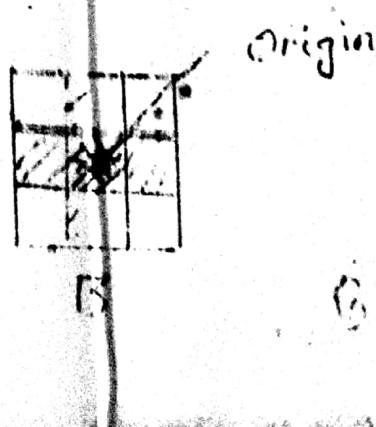
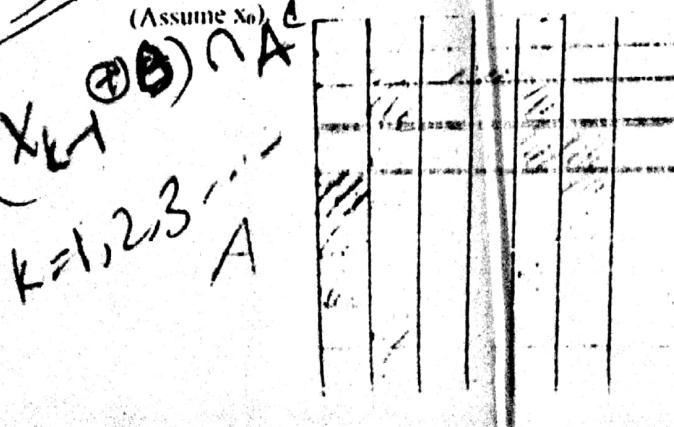
- Q.7(a) Explain the difference between fixed length coding and variable length coding with an example. 04
 Q.7(b) "Symbols with higher probability will have smaller code", explain with the application of Huffman coding. 03

- Q.8(a) Write short note on (i) LP(M) (ii) DCT (iii) Entropy and (iv) JPEG 04

- Q.8(b) What is opening? Discuss its application. Write down the application of opening and closing. 05

- Q.8(c) Describe mathematically region filling technique. Fill the region of A using structuring element B. 06

(Assume x_0)



N.B.

Answer SIX questions taking THREE from each section.
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SECTION A

- | | |
|--|--------------------------------------|
| Q1(a) What is the effect of quantization on digitization of an image?
(a) Explain gray level transformation?
(b) How does histogram can represent an image? How is the histogram of a blur image look like?
(c) What is resolution and intensity of an image? | Marks
03
02
04
02 |
| Q2(a) Design filters in the frequency domain for image blurring and image sharpening? Describe the spatial domain counter part of the same operations.
(b) Explain the significance of Fourier transformation in filter design.
(c) What is Ringing problem? How can you remove it? | 05
02
04 |
| Q3(a) What is local frequency filtering and band rejection filtering?
(b) Explain the operation of Homomorphic filtering.
(c) Show the spatial responses for Butterworth filters of various orders.
(d) Differentiate between δ -adjacency and m-adjacency. | 04
02
03
02 |
| Q4(a) Consider the following image: | 05 |

17	17	77	77	137	127	137	197
17	17	77	77	137	137	137	197
77	17	77	77	127	127	137	197
17	17	77	77	137	127	137	197

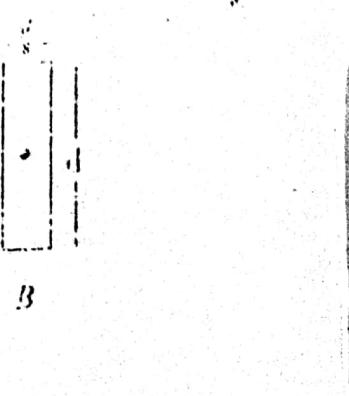
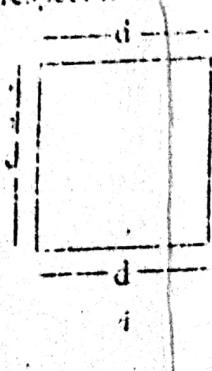
Which type of redundancy exists here? Find out the data redundancy.

Find out the entropy for image on 4(a).
 "Black and white television is not a true black and white television." Explain it.

04
 02

SECTION B

- | | |
|---|----------------|
| Q5(a) What is Differential Pulse Code Modulation (DPCM)?
(b) What is the difference between fixed length coding and variable length coding?
(c) In a given text file, the characters are distributed with the following probabilities. Find out the Huffman code, Source entropy and efficiency.
$(A, 0.3), (B, 0.1), (M, 0.4), (R, 0.06), (W, 0.07), (Z, 0.1)$ | 03
03
05 |
| Q6(a) Why DCT is used in JPEG98? What technique is used in JPEG93 for lossless compression?
(b) Explain the use of DWT in JPEG2000. | 03
02
02 |
| (c) What is image negation?
(d) Explain the difference stages of JPEG compression technique. | 04
04 |
| Q7(a) Consider the set A and structuring element E . Now find out the (i) Dilation (ii) Erosion of A with respect to B . | 03 |



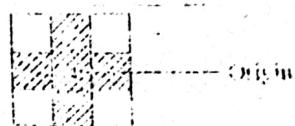
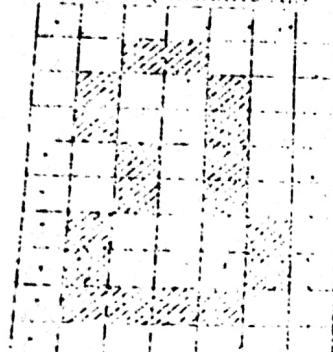
Q7 Consider the following image A and structuring element B. Now fill the boundary of A using B.



(a) What is the difference between data and information? Explain with an example.

615

Q8(a) Consider the following image A and the structuring element B. Now fill the region of A using B. (assume A₀)



B

(b) Write down the properties of erosion and closing.

6223

Q8(b) Compress the image "lena.bmp" using run length Coding. Also find out the compression ratio and data distribution.

6224

09/09/2021

4.7.3 Run Length

N.B. Answer six questions, taking three from each section.

The questions are of equal value.

Use separate answer script for each section.

24/07/2023

SECTION-A

Q1. (a) Describe region growing approach for image segmentation purpose. 7/6/3 03

(b) How split and merge technique from a Quadtree? Write down its application. 7/6/3 04

(c) How image histogram thresholding and clustering can help to segment an image? 03

(d) What is homogeneity test? 7/3 1 2/3

Q2. (a) Distinguish between spatial domain and frequency domain processing of an image? 02

(b) Describe the sampling and quantization stage of digital image formation. 5/2 03

(c) How edge along horizontal, vertical and diagonal axis can be detected? 3 2/3

(d) How contrast stretching can help to enhance an image? 2/0/6 03

Q3. (a) What is cut off frequency? Shortly describe the 2D ideal low pass filter. 3 2/3

(b) What is an I-frame in the MPEG coding system? What are the advantages of I frame in MPEG system? 03

(c) Write the properties of opening and closing. Prove that $(A \bullet B) \bullet B = A \bullet B$ 05

Q4. (a) What is a negative image? How a negative image can be obtained from the original image? 3 2/3

(b) Find the value of the center pixel of the following image if 3×3 mask and median filter are used 03

50	60	70
100	75	50
80	90	100

image

1	2	1
2	1	2
1	2	1

mask

c) What is derivative filter? Derive mathematical formulation for Roberts mask and then find Prewitt and Sobel mask. 05

SECTION-B

Q5. (a) Using the following probabilities, find out the Huffman code, source entropy and efficiency. 0.3, 0.1, 0.4, 0.06, 0.04, 0.1 04

(b) How the transformation stage help to compress an image for JPEG 2000 technique. 03

(c) Find the entropy for the following image segment 03

✓	✓	4	5 ✓	6
✓	5	✓	7	8
✓	6	5	✓	4
✓	3	7	✓	3

2.63

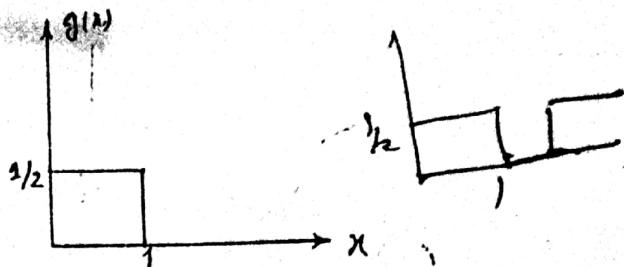
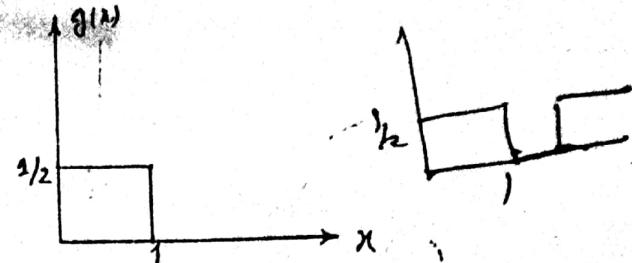
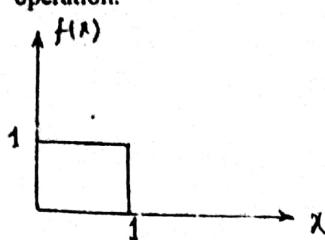
(d) What is relative data redundancy? 1 2/3

Q6. (a) Describe the separability and translation properties of two-dimensional Fourier transform. 04

(b) Show that the discrete Fourier transform and its inverse are periodic functions. $\frac{2}{3}$

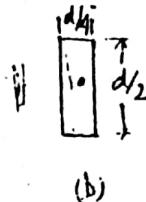
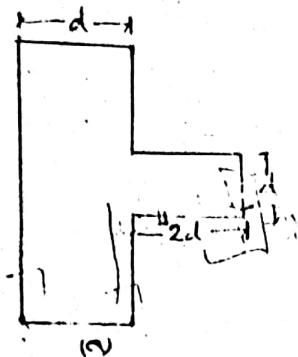
For simplicity, assume 1-D functions.

(c) Calculate graphical representation of $f(x) * g(x)$, where * denotes convolution operation. 04



Q7. (a) Describe Dilation and Erosion. 03

(b) Using the following image A and structuring element B,
Find (i) $A \oplus B$ and (ii) $A \ominus B$



(b)

(c) What is boundary extraction? 02

(d) What is region filling? 02

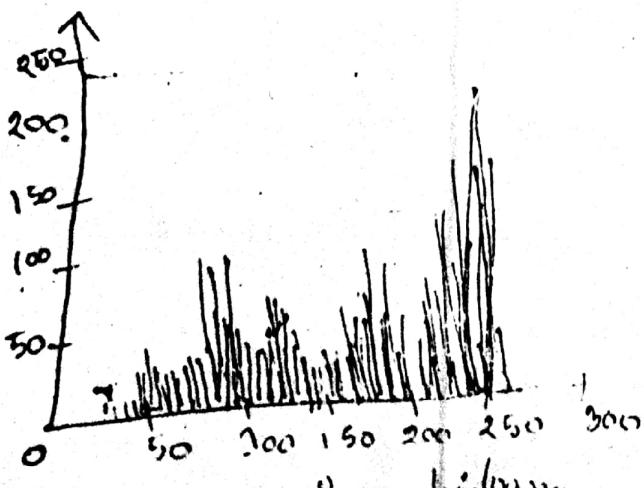
Q8. (a) Discuss briefly the procedure of resizing of an image. 04

(b) Discuss the line and point detection technique of image segmentation 69 05

(c) Define the term 'Thresholding'. What do you mean by local and global thresholding? $\frac{2}{3}$

Applications of DWT:

1.



Bar chart histogram

Use of splitting & merging
1. Content based image retrieval.

2. Machine Vision.

3. Object detection system.

4. Traffic control system.

5. Video Surveillance.

6. Recognition task.

7. Medical imaging.