Nirma University

Institute of Technology

Semester End Examination (IR), December - 2022

B. Tech. in Computer Science and Engineering, Semester-VII

2CSDE78 Digital Image Processing and Analysis

Roll / Exam No. _____ Supervisor's initial with date _____

Time: 3 hours Max. Marks: 100

Instructions:
1. Attempt all the questions.
2. Mention suitable assumptions wherever necessary.
3. Use a section-wise separate answer book.
4. Draw neat sketches wherever necessary.

SECTION I

Q.1 **Answer the following.** **[18]**

(a) **CLO1** **BL2** Define the term false contouring and checkerboard effect and their causes. [6]

(b) **CLO1** **BL2** What is a digital Image? How is a digital image in an optical band different from one in other bands like X Rays and ultrasounds? How are they interpreted? [6]

(c) **CLO3** **BL3** Consider the image segment shown. [6]
(a) Let V={0, 1} and compute the lengths of the shortest 4-, 8-, and m-path between p and q. If a particular path does not exist between these two points, explain why.
(b) Repeat for V={1, 2}.

1	2	2	2	1	q
1	1	1	0	0	
2	2	0	1	1	
1	0	1	1	1	
p1	0	0	0	0	

Q.2 **Answer the following.** **[16]**

(a) **CLO3** **BL2** Two images, f(x, y) and g(x, y), have histograms hf and hg. Give the conditions under which you can determine the histograms of [10]
(a) f(x, y)+g(x, y)
(b) f(x, y)-g(x, y)
(c) f(x, y)*g(x, y)
(d) f(x, y) , g(x, y)
in terms of hf and hg. Explain how to obtain the histogram in each case.

OR

(a) **CLO3** **BL3** Consider a 4x4 image shown below with 8 intensity levels, [10]

0	0	0	4
1	1	1	5
1	2	2	7
2	2	2	7

Sketch the histogram to describe this distribution.
Apply discrete transformation and find how many pixels/grey levels would be in an equalized version of this histogram.
Sketch the histogram of the equalized image.

(b) **CLO3** **BL2** What is the reason behind the ringing effect when the frequency domain ideal filter is used? How can it be removed? [06]

OR

(b) **CLO3** **BL2** What is the significance of zero-crossing in image segmentation? How can zero-crossing be detected? [06]

Q.3 **Answer the following.** **[16]**

(a) **CLO2** **BL4** Which kind of transformation(s) can be applied when: [04]

1) Image is either too dark or too light.
2) Image contains salt-and-pepper noise.
3) Image is blurred.
4) Image is generated with poor illumination.

(b) **CLO4** **BL3** Find out first-order and second-order derivatives for the 1D scan line given below: [06]

10 10 10 11 12 13 14 15 15 15 20 15 14 13 12 11

(c) **CLO4** **BL3** Find DFT coefficients for the following image. [06]

$$A = \begin{bmatrix} 2 & 3 & 10 \\ 4 & 9 & 12 \end{bmatrix}$$

SECTION II

Q.4 **Answer the following.** **[18]**

(a) **CLO3** **BL3** Give and justify which thresholding method is used when [06]

1) Between-class variance is needed to be exploited.
2) Image is corrupted by spot shading.

OR

(a) **CLO3** **BL2** Why do we need to multiply an image with $(-1)^{+(x+y)}$ when x and y are the index value of the pixel location before taking the Fourier transform explain? [06]

(b) **CLO1** **BL4** What are the types of image compression techniques? Explain run length coding; which category will you keep run length coding into? [06]

(c) **CLO2** **BL6** Draw a block diagram to implement a quality assurance system in a pharma company to ensure all the bubbles in the blister are filled with tablets. Also, elaborate on the approach. [06]

Q.5 **Answer the following.** **[16]**

(a) **CLO1** **BL2** What are the colour models? What is the HSV model, and when is it used?. [04]

(b) **CLO3** **BL2** A good edge detection algorithm ensures that the edge is 1. one pixel wide 2. has only the strong edges 3 without discontinuity. Explain how canny edge detection addresses each of these objectives. Write a to-the-point answer. [06]

(c) **CLO2** **BL4** The median filter is a method to remove the salt and pepper noise. But this also can lead to crucial information loss in the image. Write an algorithm that can use the strength of the median filter while minimizing the information loss. Consider that image has salt and pepper noise. [06]

Q.6 **Answer the following.** **[16]**

(a) **CLO3** **BL4** What are the limitations of restoring the image by inverse filtering even if the degradation function is obtained correctly? How to overcome that? [04]

(b) **CLO3** **BL5** Explain what would happen in binary erosion and dilation if the structuring element is a single point value 1. Give reason(s) for your answer. [06]

(c) **CLO4** **BL3** For the image given below, find the co-occurrence matrix for distance 1 and angle 0 degrees. [06]

$$F(x,y)= \begin{matrix} 2 & 1 & 4 & 0 \\ 3 & 2 & 3 & 3 \\ 4 & 5 & 2 & 1 \\ 2 & 4 & 1 & 2 \end{matrix}$$

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