Exam Date & Time: 03-Jul-2023 (02:30 PM - 05:30 PM)



## **MANIPAL ACADEMY OF HIGHER EDUCATION**

### SIXTH SEMESTER B.TECH MAKE UP EXAMINATIONS, JULY 2023

#### **DIGITAL IMAGE PROCESSING [BME 3252]**

**Duration: 180 mins.** 

# Marks: 50

### Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Consider the system with input-output relationship:  $y(m,n) = x^2(m, n)$ . Find out if the system is linear, shift-invariant and causal. Justify each of your answers mathematically. (CO1, BT-4) (3)

A)

- B) It is often sufficient to understand the behaviour of a filter in 2D, by examining its equivalent in 1D. Accordingly, find the expression for the frequency response of the system described in terms of the input-output relationship: y(n) = (1/2)[x(n) - x(n-1)]. Plot the magnitude of the frequency-response, (3) and comment on the result. (CO1, BT-4)
- C) Explain the match-band effect associated with the human visual system, and draw appropriate conclusions (CO2, BT-2)
- 2) Find the Huffman-code-table towards compressing the following image (Fig. 1). Assume that the given image is a 5-bit image.

A)

(4)

А

5	5	5	10	10	10	5	10	16
5	5	5	10	10	10	5	16	16
16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	24	24
24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24
24	24	24	24	15	15	15	15	15
15	15	15	15	15	15	15	15	15
15	15	15	15	15	15	15	15	15

### Figure 1

Calculate the compression ratio. (CO3, BT-3)

B) Perform contrast-stretching by histogram-equalization, of the image in Fig. 2.



### Figure 2

If the j.n.d. assocated with an observer is 2 units, comment if the transformation has achieved anything. (CO3, BT-4)

3) Find the output of the <u>5-point Median Filter</u>, on the image shown in the following (Fig. 3): (CO3, BT-4)

A)

BME 3252

about:srcdoc

8	8	8	8	12	12	12	12
8	50	8	8	12	12	12	25
8	8	8	8	12	12	25	12
8	8	8	8	12	25	12	12
12	12	12	12	25	12	12	12
12	12	12	25	12	12	12	12
12	12	25	12	12	12	0	12
12	25	12	12	12	12	12	12

### Figure 3

Show three examples demonstrating as to how you got the output. Draw the final image.

B) Find the output of the <u>weighted-averaging filter (Fig 4) i.,e., filter whose mask is:</u>

(4)



### Figure 4

on the image given in Q. 3(A) i.e., Fig. (3) (CO3, BT-4).

	C)	Compare the results of $Q(8)$ and $(9)$ , and draw conclusions by pointing out to the changes in the images. (CO3, BT-4)	(2)
4)		Develop from fundamentals, the Laplacian-based edge-detection scheme. (CO3, BT-2)	(5)
	<b>A</b> )		(5)
	B)	Write a pseudo-code to detect the presence of straight lines of the form:	
		$x\cos(\emptyset) + y\sin(\emptyset) = t$	
		in digital images. You must include the pseudo-codes for initialization & thresholding. (CO4, BT-4).	(5)

- 5) Find the result of (i) opening, and (ii) closing, of the object shown in the following image, by a small circular structural element shown by its side. Assume that the radius of the circular structuring element is *R*.
  - A)





(5)

You must show all the details and all intermediate results concerned, clearly. (CO3, BT-3).

B) Apply connected component labelling to the following image, based on:

(a) 8-Neighbourhood

(b) 4-neighbourhood.

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

### Figure 6

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Sketch the connected components clearly in a separate image. Find the number of blobs in both the cases. (CO3, BT-3)

-----End-----