Question Paper

Exam Date & Time: 27-May-2023 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY-JUN 2023

DIGITAL IMAGE PROCESSING [BME 3252]

Marks: 50

Duration: 180 mins.

Answer all the questions.

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

1)	(a) Consider the system with input-output relationship: $y(m,n) = 1.5 x(m - 1, n - 1)$. 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: $y(n) = (1/3)[-x(n-1) + 2x(n) - x(n+1)]$. Plot the magnitude of the frequency-response, and comment of the result. (CO1, BT-4)	(3) า
C)	Explain the psycho-visual experiment towards determining the ability of the human visual system to distinguish two visual stimuli. How does the conclusion modify, when extended to the case of infinitesimal changes in the visual stimulus? What is the conclusion? (CO2, BT-2)	(4)
2)	Find the Run-length code pertaining to the following image (Fig. 1), using 3-bit codes (with levels ranging from 0 to 7).	(4)

A)

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



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

B)

Consider the contrast-stretching transformation in Fig. 2(a).



Figure 2(a)



Figure 2(b)

(a) Find the equations pertaining to the transformation. (b) Construct the Look-up table (LUT) for the transformation, from the equations. (c) Apply the transformation on the image in Fig. 2(b). (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)



(4)

5	J	5	13	13	13	13	тЭ
5	5	5	15	15	15	15	15
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5

Figure 3

B) Find the output of the <u>5-point averaging filter i.,e., filter whose mask is:</u>

	0.2	
0.2	0.2	0.2
	0.2	

C)

A) B)

4)

 on the image given in the previous question 3(A) i.e., that pertaining to the median filter i.e., Fig. (3) (CO3, BT-4).
 (2)

 Compare the results of Q 3(A) and (B), and draw conclusions. (CO3, BT-4)
 (2)

 Develop from fundamentals, the gradient-based edge-detection scheme. (CO3, BT-2)
 (5)

 Write a pseudo-code to detect the presence of parabolae of the form:
 (5)

 $y = a x^2 + bx + c$ (5)

in digital images. You must include the pseudo-codes for initialization & thresholding. (CO4, BT-3).

(a) 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 (5) the radius of the circular structuring element is *R*.

A)

5)

(4)



You must show all the details and all intermediate results concerned, clearly. (CO3, BT-3) . Apply connected component labelling to the following image, based on:

B)

(a) 8-Neighbourhood

(b) 4-neighbourhood.

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

(5)

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

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

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