Exam Date & Time: 17-May-2022 (10:00 AM - 01:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY - 2022

DIGITAL IMAGE PROCESSING [BME 3252]

Marks: 50 **Duration: 180 mins.**

A

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: $y(m,n) = 2\,x(m-1, n-1) + 1$. Find out if the system is linear, shift-invariant, causal and stable. Justify each of your answers mathematically. (4)

A)

B) How would you compute the 2D DFT using an FFT algorithm? Justify your answer mathematically. (3)

C) Consider filtering a 2D sequence of size 450×360. The size of the filtering kernel is 25×25. Find the number of zeros to be padded to the two sequences, to allow linear filtering by the kernel, using an FFT algorithm (2 Marks) (3)

2) Explain the Match-band effect, and list the important conclusions. (4)

A)

B) Find the Huffman-code table, to compress the image given in the following. (6)

8	8	8	10	10	10	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	25	25	25	25	25
25	25	25	25	25	25	25	25
25	25	25	25	25	25	25	25

Compute the compression-ratio (CR).

3) Explain the concept behind the Hough-transform, to detect the presence of straight-lines in an image.. (2)

A)

B) Write a pseudo-code to detect the presence of circles of the form:

$$(x - h)^2 + (y - g)^2 = r^2$$

in digital images. (4)

C) Find the Histogram-equalized version of the image shown in the following.

5	5	6	6	6	6	6
5	5	6	6	6	6	6
5	5	6	6	6	6	6
5	5	6	6	6	6	6
5	5	6	6	6	6	6
5	5	5	5	5	5	5
5	5	5	5	5	5	2

(4)

4) Develop from fundamentals, the Laplacian-based edge-detection scheme. (5)

A)

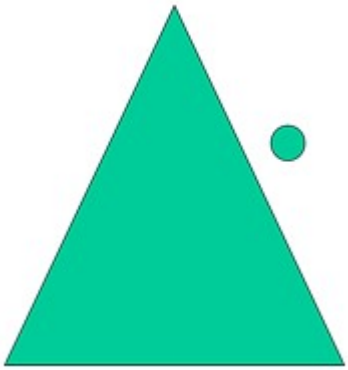
B) Find the output of the 5-point Median Filter, on the image shown in the following:

5	5	5	15	15	15	15	15
5	5	5	15	15	15	15	15
5	25	5	15	15	0	15	15
5	5	5	15	15	15	15	15
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

Point out the important changes. (5)

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

A)



You must show all the intermediate results, clearly. (4 Marks)

(b) What is the result of closing an object by itself? Explain your answer. (1 Mark) (5)

B) Apply connected component labelling to the following image, based on:
(a) 8-Neighbourhood
(b) d-(diagonal) neighbourhood. (5)

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

Find the number of blobs in both the cases.

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