

**B.E. INFORMATION TECHNOLOGY FOURTH YEAR SECOND SEMESTER – 2024
DIGITAL IMAGE PROCESSING**

Time: 3 hours

Full Marks: 100

CO1: Attempt either {a, b} or {c, d}

8 + 7 = 15

- a) Write an algorithm to find out the 4-connected components of a binary image.
- b) Consider the following binary matrix and find the components using the above algorithm.

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

- c) Consider the image segment shown below. Determine (i) Euclidean, (ii) city-block, (iii) chess-board distances between P and Q.

Q							
							P

- d) State the condition(s) when these distances become equal.

CO2: Attempt any **two (2)** questions

2 × 8 = 16

- a) Consider FFT computation. Show that the number of addition operations involved is $a(n) = 2a(n-1) + 2^n$, and the number of multiplication operations involved is $m(n) = 2m(n-1) + 2^{n-1}$, where $N=2^n$.
- b) Prove that the inverse Fourier transform (IFT) can be implemented using the forward FT procedure.
- c) Consider the following basis images of size 4×4, and transform the matrix A using the given images, where $\frac{1}{4}$ is the transform constant.

$$A = \begin{pmatrix} 25 & 30 & 30 & 35 \\ 20 & 25 & 25 & 40 \\ 20 & 25 & 25 & 40 \\ 40 & 35 & 35 & 45 \end{pmatrix}$$

[Turn over

	v = 0	v = 1	v = 2	v = 3
u = 0	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
u = 1	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1
u = 2	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
u = 3	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1
	1 1 1 1	1 1 -1 -1	1 -1 -1 1	1 -1 1 -1
	-1 -1 -1 -1	-1 -1 1 1	-1 1 1 -1	-1 1 -1 1

Basis images of size 4×4 for question CO2.c

CO3: Attempt any **three (3)** questions

$3 \times 5 = 15$

- Suppose a digital image is subjected to histogram equalization. What will be the output if the image is processed by histogram equalization a second time? Justify your answer.
- What linear transformation will change an image $f(x,y)$ with gray levels ranging from 4 through 18 to an image $g(x,y)$ with gray levels ranging from 10 through 50?
- What are the differences between the mean filter and median filter? Which one is suitable in what situation?
- Explain how **log transformation** can enhance image quality.

CO4: Attempt any **three (3)** questions

$3 \times 6 = 18$

- Find the global threshold to threshold the following matrix, using 5 as the initial threshold.

76	71	82	44	49
74	3	69	38	45
39	28	32	77	65
66	5	95	80	71
17	10	3	19	75

- c) Consider the following 4×4 block, and encode the block using the Block Truncation Coding (BTC) method. Also, find the mean-square error between the input and reconstructed blocks.

120	125	128	130
122	125	127	132
125	122	132	130
134	129	134	130

- d) Consider the following symbols and their probability of occurrence. For an input string 'abcdcba,' what will be the encoding string according to Arithmetic coding?

Symbol	a	b	C	d
Probability	0.3	0.2	0.3	0.2

CO1: **Review** the fundamental concepts of digital image processing (K2)

CO2: **Analyze** images in the transform domain using different transforms like FT, DCT, HT, KLT, etc. (K3)

CO3 : **Demonstrate** the techniques for image enhancement. (K3)

CO4: **Illustrate** different techniques of Image segmentation including morphology. (K3)

CO5 : **Interpret** image representation and description techniques. (K3)

CO6 : **Describe** and illustrate various image compression techniques. (K3)
