B.E. INFORMATION TECHNOLOGY FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY – 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 8-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) State and prove the separability property of the Fourier transform.

b) Prove that Fourier transform (FT) is a global processing method.

c) What is basis image of a transformation? Define transformation with help of basis images.

CO3: Attempt any **three (3)** questions 3 × 5 = 15

a) What is smoothing filter? What is median filter? How these two filters are different?

b) What linear transformation will change an image f(x,y) with gray levels ranging from 4 through 14 to an image g(x,y) with gray levels ranging from 10 through 20?

c) Define power law transformation with graph.

d) Explain how ***log transformation*** can enhance image quality.

CO4: Attempt any **three (3)** questions $3 \times 6 = 18$

a) Find the global threshold to threshold the following matrix, using 1 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

b) How can the horizontal lines be detected from a grayscale image?

c) Design an algorithm, using morphological operations, to fill up a region of a binary image.

d) A binary image A and a structure element B are given below. What does the resulting image look like after applying the opening operation on this image with B as a structuring element? Comment on the result

A=

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

B=

1	1	1
1	1	1
1	1	1

CO5: Attempt any **three (3)** questions $3 \times 6 = 18$

a) Consider the following shape and find its shape number.

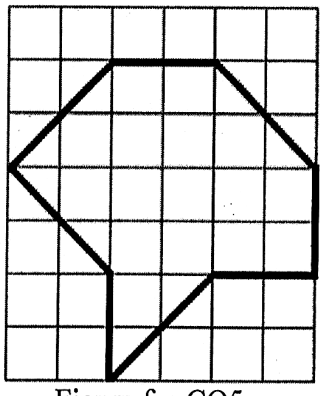

Figure for CO5.a

1	2	0	6	2
3	4	1	2	4
5	7	0	4	5
3	0	1	7	5
7	0	0	0	4

Matrix for CO5.b

b) Consider the matrix given in the above figure, with intensity range [0-7], and compute the GLCM matrix for $\Delta x = 1$, $\Delta y = 2$ (x is along the row and y is along the column).

c) Name four regional descriptors and define them.

d) Name four boundary descriptors and define them.

CO6: Attempt any **three (3)** questions $3 \times 6 = 18$

a) In Huffman coding scheme, when average ode length is maximum? Prove it.

b) Write the pseudo code of the encoder of vector quantization, where the size of the pattern-book is $K=2^t$, and patterns are $\{P_1, P_2, \ldots, P_K\}$, each vector is of d-dimensional and input vector is $X=(x_1, x_2, \ldots, x_d)$.

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.

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

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

Symbol	a	b	c	d	e
Probability	0.2	0.2	0.2	0.2	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)
