(i) Attempt the Question one Q1 in the first page of answer sheet.

(ii)Attempt all parts of a question consecutively.

(iii) Full credit will only be given if the Solution is neat, and showing all the required steps.

Q1. Short answers (Justify your answer):

a) How can you avoid blurring effect in an image when it is smoothing by average filter?

b) What are the different types of noises possible in an image?

c) Is there any segmentation method that does not depend on the availability of models for the distributions of the object and the background pixels?

d) When is histogram matching technique preferred than histogram equalization?

e) What are the advantages of using principal components to present an image?

f) Is it possible for given matrix C to represent covariance matrix of a three-band image? Justify your answer.

-1	0	1
0	1	-2
-2	2	0

g) Write the X-Ray image's pixel intensity in ascending orders according to their CT number (attenuation):   i) Bone, ii) Blood, iii) Brain and iv) water.

h) What are the physical phenomena used in medical image signal acquisition?

i) Suggest suitable medical imaging techniques for following applications:
        (i) Fracture in bone   (ii) Blood flow measurement.

j) What are the desirable properties of image descriptor?   **[2x10]**

Q2. a) Find the signature of the image:

$$1 \quad 1 \quad 1 \quad 1$$
$$1 \quad 0 \quad 0 \quad 1$$
$$1 \quad 0 \quad 0 \quad 1$$
$$1 \quad 1 \quad 1 \quad 1$$

b) Using Otsu's method, find the threshold of the 4x4 3-bit image.

$$5 \quad 6 \quad 5 \quad 5$$
$$6 \quad 5 \quad 5 \quad 6$$
$$7 \quad 6 \quad 4 \quad 5$$
$$5 \quad 5 \quad 5 \quad 5$$

                                                                    [5+15]

Q3. a) Design suitable structural element to extract the boundary of given image by morphological operation. (use zero padding)

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \end{bmatrix}$$

b) Given 4x4 4-bit reference and input images respectively use histogram matching to restore the input image.

4	4	3	3
4	4	4	3
5	4	4	4
4	4	4	4

15	15	0	0
15	15	15	0
15	15	15	15
15	15	15	15

[5+15]

Q4. (a) Find the compactness of features as '1' , '2' and '3' in image

```
00000000
00100110
01101100
00111100
01111000
00000330
02200330
22200330
```

b) In Hough Transform, a line is defined in terms of parameters (ρ , θ). Find out the intersection coordinates (x, y) of the intersection of two lines when they are a) parallel and b) perpendicular.

[10+10]

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
I Semester 2023-2024
EEE F435 Digital Image Processing
Comprehensive Examination (Closed Book)

MM: 40   **6ᵗʰ Dec'23**   **Time: 60 minutes**

(i) Attempt all parts of a question consecutively.

(ii) Full credit will only be given if the Solution is neat, and showing all the required steps.

Q1. Given 2-band mages of 2x2, find the corresponding PCA components and their covariance.

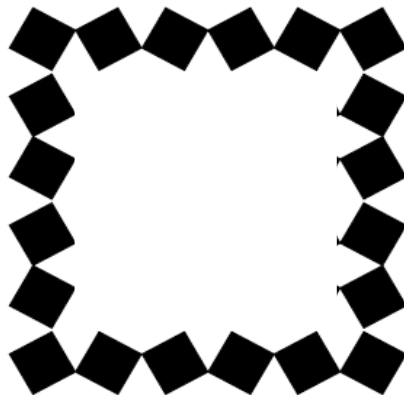$$\begin{matrix} 2 & 1 \\ 3 & 6 \end{matrix} \qquad \begin{matrix} 3 & 2 \\ 1 & 2 \end{matrix}$$

[15]

Q2. Find the decision line between three classes of Iris Flowers: versicolor, Virginica and setosa data.

Setosa		Vericolor		Virginica	
Length	Width	length	width	length	width
1.8	0.4	5.1	1.2	2.0	3.5
1.1	0.3	5.1	1.1	2.2	3.0
1.9	0.3	3.3	1.6	2.4	3.1
1.5	0.2	2.8	1.4	2.1	3.3
1.4	0.2	5.5	1.2	2.2	3.0
1.3	0.4	4.3	1.3	2.1	3.2

[15]

Q3. Find out primitive element of the given regular image pattern and define the rules to produce the same pattern.

[10]