BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

I Semester 2022-2023

EEE F435 Digital Image Processing

Comprehensive Examination (Closed Book)

MM: 90 **23th Dec'22** **Time: 120 minutes**

(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 answer (one line)

a) What is the use of statistical descriptors in image processing? Give one application.

b) What is the advantage of separable filter in image processing?

c) Why is image restoration required?

d) What type of features are enhanced by given filters?

−1	2	−1
−1	2	−1
−1	2	−1

−1	−1	−1
2	2	2
−1	−1	−1

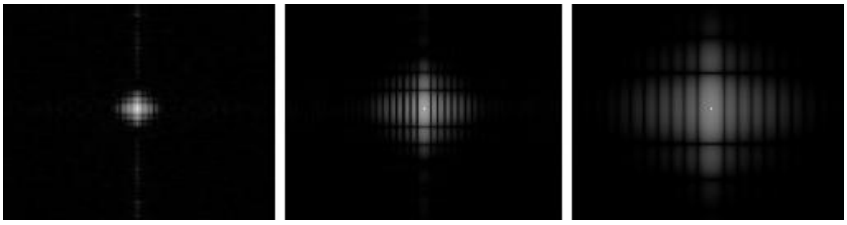
e) How does the split and merge method works?

f) How can the threshold obtained under variable illumination?

g) Are there any drawbacks of Otsu's method?

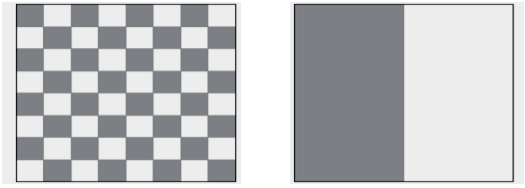
h) Match the given images a, b, and c with its Fourier transform i, ii, and iii.

(a) (b) (c)



(i) (ii) (iii)

i) Draw the histogram plot for given images a and b.



(a) (b)

j) Two images are processed by Filter X and results are shown below. Identify the type of the filter X

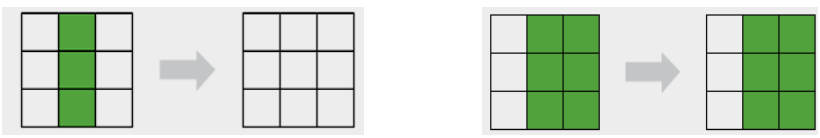


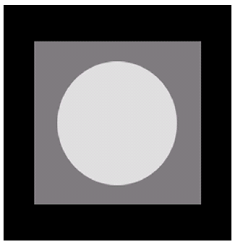
Image 'a' Image 'b' **[2x10]**

Q2. a) Write the difference of simple and Isotropic low pass filter with one example of each.

b) Find the 2-D DFT of the given spatial filter.

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

c) Identify the types of redundancies in given image to use in compression.



[5x3]

Q3. a) Find out information content of given images. Which one can be compressed more? Suggest a suitable variable length code for given images to compress it.

21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243
21	21	21	95	169	243	243	243

21	0	0	74	74	74	0	0
21	0	0	74	74	74	0	0
21	0	0	74	74	74	0	0
21	0	0	74	74	74	0	0

b) What is blocking artifact? Why is it observed in DCT compression?

[10+5]

Q4. (a) Write the difference between chain code, difference code and shape number.

(b) Describe the effects of the linear filters in image with the following kernels.

$$H_1 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}, \quad H_2 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 0 \end{bmatrix}, \quad H_3 = \frac{1}{3} \cdot \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

(c) Identify the name of these filters mash.

0	−1
1	0

(a)

1	0	−1
1	0	−1
1	0	−1

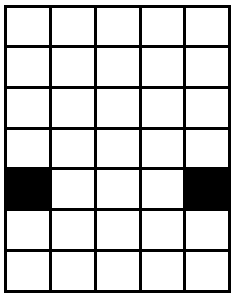
(b)

1	0	−1
2	0	−2
1	0	−1

(c)

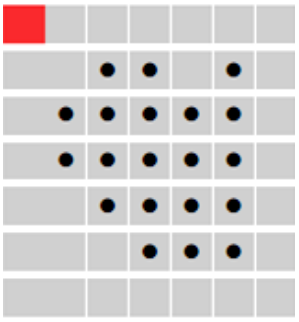
[5x3]

Q5. Draw the Hough transform (θ-ρ) for given binary image by proper selection of bins. Find the line equation by plot.



[15]

Q6. Design the structural element to extract image (b) from the original image (a) by morphological operations. (Write all the required steps)



(a)

(b)

[10]

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I Semester 2022-2023

EEE F435 Digital Image Processing

Comprehensive Examination (Open Book)

MM: 45 **23th Dec'22** **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. a) For the given 4 Vectors $x_1=(1\ 1\ 0)^T$; $x_2 = (1\ 0\ 0)^T$; $x_3 = (0\ 0\ 0)^T$; $x_4 = (1\ 0\ 1)^T$. Find the covariance matrix of this data X and interpretate its elements values.

b) The auto covariance matrix of 4 band spectral image is given below; find the Principal Components to represent these images and comments of the significance of these PCs.

3	0	-1	0
0	3	0	-1
-1	0	3	0
0	-1	0	3

[5+10]

Q2. The grey level values of the object and background pixels are distributed according to the probability density function:

$$p(x) = \frac{\pi}{4a}\cos\frac{(x-b)\pi}{2a}$$ for $(b-a) \le x \le (b+a)$; $p(x) = 0$ otherwise

With b = 1, a = 1 for the object and b = 3 and a = 2 for the background.

a) Sketch the two distributions and determine the range of the possible threshold.

b) If the object pixels are one-third (1/3) of the total number of pixels, determine the threshold that minimizes the fraction of misclassified pixels. [20]

Q3. For the given patch of binary image find the Manhattan distance at each of background pixel '0' from nearest foreground pixel. The fore ground pixel value is '1'. Then apply watershed algorithm to find catchment areas and crest lines.

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

[10]