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Vellore Institute of Technology

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Reg. No. : 21BCE5755

Final Assessment Test (FAT) - May 2024

Programme	**B.Tech.**	Semester	**WINTER SEMESTER 2023 - 24**
Course Title	**DIGITAL IMAGE PROCESSING**	Course Code	**BCSE403L**
Faculty Name	**Prof. M. Braveen**	Slot	**E1+TE1**
		Class Nbr	**CH2023240501730**
Time	**3 Hours**	Max. Marks	**100**

General Instructions:

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Section - I

Answer all questions (4 X 10 Marks = 40 Marks)

01. Using mathematical tools for digital data processing, execute a set operation on three distinct images representing ROIs within a larger dataset. The ROIs are defined by the following images: **[10]**

- Image A: Contains the number 0
- Image B: Contains the number 8
- Image C: Contains the number 9

Perform the set operation: (A^C union B^C Intersection C) on the given matrices. Provide the resulting image after performing the set operation, indicating the final areas of interest in the processed dataset.

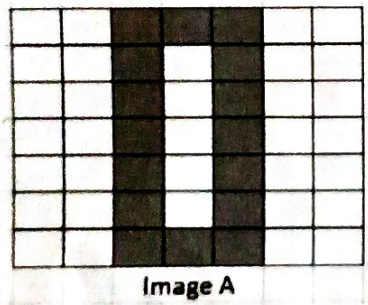


Image A

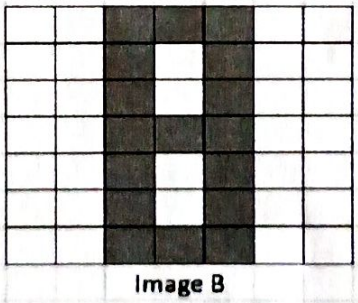


Image B

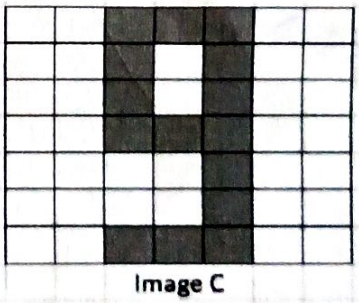
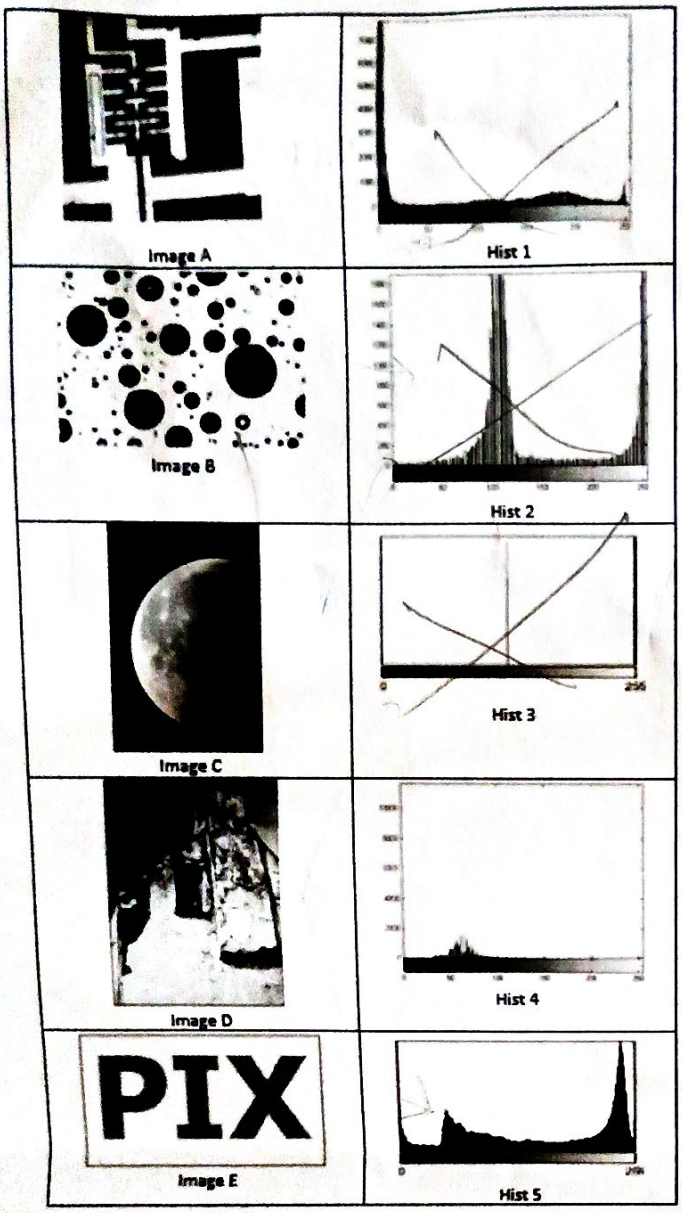


Image C

02. Match each image (A, B, C, D, E) on the left with its corresponding histogram (Hist 1, 2, 3, 4, 5) on the right. Explain why you've made each match based on the characteristics of the images and histograms. **[10]**



03. a. Consider an M x M pixel gray level image f(x,y) which is zero outside $0 \leq x \leq M$-1 and $0 \leq y \leq M$-1. The image intensity is given by the following relationship **[10]**

$$f(x,y)=\begin{cases} c, & x=x_1, x=x_2, 0 \leq y \leq M-1 \\ 0, & \text{otherwise} \end{cases}$$

where c is a constant value between 0 and 255 and x_1, x_2 $x_1 \neq x_2$ are constant values between 0 and M −1.

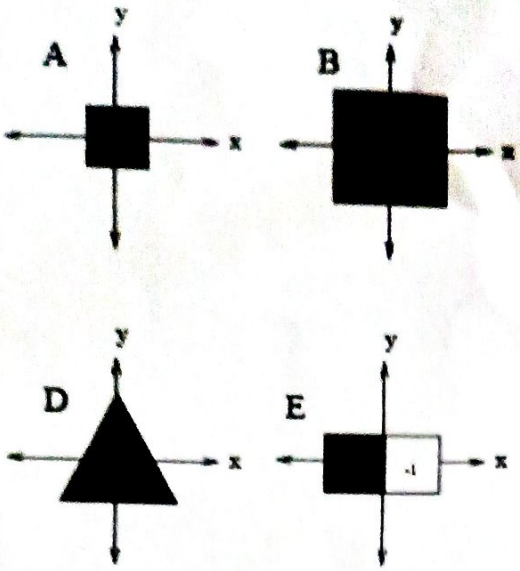
(i) Plot the image intensity **[2 marks]**

(ii) Find the M X M -point Discrete Fourier Transform (DFT) of f (x, y). **[3 Marks]**

(b) Consider the images shown below (A,B,D and E). Using knowledge of properties of the two-dimensional Discrete Fourier Transform symmetry and not exact calculation of it, list which image(s) will have a two-dimensional Discrete Fourier Transform $F(u,v)$ with the following properties: [note: images have embedded numbers too]. Explain your choices.

(i) The imaginary part of $F(u,v)$ is zero for all u,v. **[3 marks]**

(ii) $F(0,0)=0$ **[2 marks]**



04. (i) In offset digital printing presses four colour printing is used. True black colour is the predominant colour in printing. Use the appropriate properties of primary and secondary color models and equations to derive the black colour used to facilitate image processing tasks. **[5 Marks]** **[10]**

(ii) Convert RGB (Red,Green,Blue) Values to HSI (Hue,Saturation,Intensity) in the range [0-1] R=32,G=88,B=111 **[5 Marks]**

Section - II

Answer all questions (4 X 15 Marks = 60 Marks)

05. a. Use the region growing algorithm to segment the image patch given below. The seed for the object is the center of the image. Apply the algorithm in the following 2 aspects. **[15]**

10	10	10	10	10	10	10
10	10	10	69	70	10	10
59	10	60	64	59	56	60
10	59	10	60	70	10	62
10	60	59	65	67	10	65
10	10	10	10	10	10	10
10	10	10	10	10	10	10

i. Region is grown in horizontal and vertical directions, and when the difference between two pixel values is less than or equal to 5. **[4 Marks]**

ii. Region is grown in horizontal, vertical and diagonal directions, and when the difference between two pixel values is less than or equal to 5. **[4 Marks]**

b. What is the limitation of histogram-based methods for finding regions in an image? How can this be overcome in most applications? Can you suggest a postprocessing method for correcting the results obtained using a histogram-based method for images that contain objects that do not have Gaussian distributions for their intensity values? **[7 Marks]**

06. a. Consider a real-world application of handling an image shown in Figure (a) to obtain its skeleton as shown in Figure (e). There is an algorithm already followed by the application for this task, which is not explicit. However, you can see the step wise intermediate results of the algorithm. They are shown below: **[15]**

(a) (b) (c) (d) (e)

(a) Original Image; (b), (c), (d) Intermediate Stages; (e) Skeleton of the image

i. Decode the algorithm, getting clues from the intermediate results shown in Figure 1 (b), (c), and (d). **[3 Marks]**

ii. Identify the image processing operation used in each stage. **[2 Marks]**

iii. In case of any morphological operator use, identify the following **[5 Marks]**

1. Structuring element and its size
2. Morphological operator and estimate of no. of times of application

b. Is there any difference in the final result between applying a 3×3 square structuring element twice to an image, and applying a 5×5 square structuring element just once to the image? Which do you think would be faster and why? **[5 Marks]**

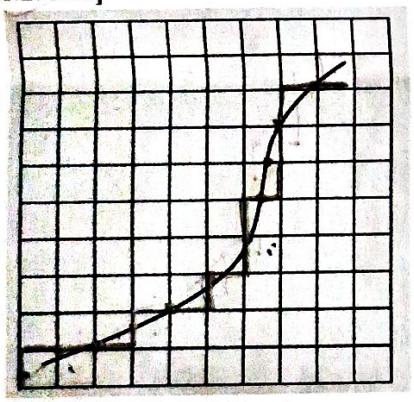
07. Consider the simple 6x11 image: **[15]**

31	32	224	222	128	128	128	224	223	31	33
33	33	224	222	129	2	128	224	222	32	255
33	31	224	222	128	128	129	4	224	32	32
64	65	224	222	128	128	128	224	223	63	65
255	64	223	4	224	224	222	223	222	63	64
64	64	223	223	224	224	224	222	223	64	65

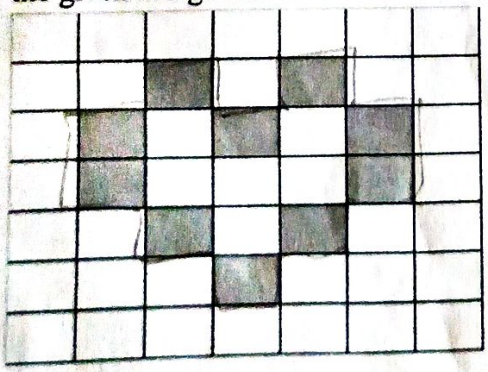
a) Compute the entropy of the image. **[6 Marks]**

b) Compress the image using Huffman coding **[9 Marks]**

08. a. Construct a 4-directional and 8-directional chain code for the arbitrary shape given below: **[6 Marks]** **[15]**



b. Consider the application of image analysis in computer vision. Utilizing the 8-chain code method, describe how you would encode the boundary of a given image. Apply this method to the given image and determine its shape number. **[9 Marks]**



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