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**PRESIDENCY UNIVERSITY
BENGALURU**

**SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023**

Semester : Semester IV - 2021

Course Code : ECE3029

Course Name : Sem IV - ECE3029 - Digital Image Processing

Program : ECE

Date : 16-JUN-2023

Time : 9.30AM - 12.30PM

Max Marks : 100

Weightage : 50%

Instructions:

- (i) Read all questions carefully and answer accordingly.
 - (ii) Question paper consists of 3 parts.
 - (iii) Scientific and non-programmable calculator are permitted.
 - (iv) Do not write any information on the question paper other than Roll Number.
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PART A

ANSWER ALL THE QUESTIONS

(5 X 2 = 10M)

1. Blur filters and Deblur filters are useful in Image degradation and Restoration model. Find the transfer function of the Deblur filter using Inverse filtering technique if the transfer function of the Blur filter is $H(X,Y)$.
(CO3) [Knowledge]
2. Morphological operations are used to modify the shape of an image. Sets in mathematical morphology represent objects in an image. If set $A = \{2, 3, 5, 7\}$ and set $B = \{2, 4, 5, 6, 8, 10\}$, then find $A - B$ and $B - A$.
(CO4) [Knowledge]
3. A bit plane of a digital discrete signal (such as image or sound) is a set of bits corresponding to a given bit position in each of the binary numbers representing the signal. Briefly discuss the importance of bit planes in digital image processing.
(CO2) [Knowledge]
4. The total number of bits in an image depends upon the type of the image used. Find the total number of bits in 8x8 colour image.
(CO1) [Knowledge]
5. Edges are the pixels where brightness changes abruptly. Various operators are used for edge detection. Differentiate between Prewitt and Sobel operators.
(CO3) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS

(2 X 15 = 30M)

6. (a) Detecting an edge in an image is a part of Image segmentation. An edge in an image can be efficiently detected using the 1st derivative and the 2nd derivative of the edge profile. For the image strip given below, analyze the image strip by computing the 1st and the 2nd derivative.

Image strip 5, 5, 4, 3, 2, 1, 0, 0, 0, 6, 0, 0, 0, 0, 1, 3, 1, 0, 0, 0, 0, 7, 7, 7, 7

[8M]

- (b) To restore the degraded image, image restoration algorithms are widely used. Inverse filters, Pseudo inverse filters and Wiener filters are the deblur filters popularly used for image restoration. Design the deblur filter using the inverse filtering technique for the Blur filter $h(x, y)$ given below.

[7M]

$h(x,y) =$

0	0.1	0.1	0
0.1	0.1	0.1	0.1
0.05	0.1	0.1	0.05
0	0.05	0.05	0

(CO3) [Comprehension]

7. (a) H is a general operator, that operates on the input image $f(x,y)$ to produce an output image $g(x,y)$.

[6M]

(i) Considering $F1=[2 \ 3 \ 9; 0 \ 2 \ 7]$, $F2=[4 \ 7 \ 2; 6 \ 5 \ 0]$ with $a1=1$ and $a2=-1$ for the Operator $H=MAX$, The output of the system depends on the nature of the operator used in the system. Identify the nature of the given operator.

(ii) Repeat the above problem for the operator $H= MIN$

8. The purpose of image enhancement is to provide 'better' input for the other system to improve the interpretability or perception of information in images for human viewing. Say a 3 bit 5x5 size digital image is obtained of VIDHANA Soudha (foreground) with tourists (background) using camera. Perform Translation by a Translation vector (3,3) and then rotate the resultant image by 90° clockwise for the image formed by the coordinates (0,0), (4,0), and (0,3)

[9M]

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

(CO1,CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

(3 X 20 = 60M)

8. Image compression is a process applied to a graphics file to minimize its size in bytes without degrading image quality below an acceptable threshold. By reducing the file size, more images can be stored in a given amount of disk or memory space.

(i) Implement the Huffman coding and generate the code for the image pixels $y_1, y_2, y_3, y_4, y_5, y_6, y_7$ having the probabilities 0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05

(ii) Compute the Compression Ratio, Redundancy and Average length of the code.

(CO3) [Application]

9. a) Many features in the Gray Scale Images can be better analysed if they are mapped with different colours. Various techniques and algorithms are in use to achieve this. Apply and illustrate any technique or algorithm to convert the Gray Scale Image to colour image. [4M]
- b) a) Erosion and Dilation are the two popularly used algorithms in Morphological image processing to shrink and expand the image respectively. The Morphological operations in general are typically applied to remove imperfections introduced during segmentation and to eliminate noise. Morphological operations on the given image are performed by the structuring element. Apply this concept to perform the following operations on the image A using the structuring element B.
- (i) A Erosion by B (ii) A Dilated by B (iii) A^c Erosion by B (iv) A^c Dilated by B. Note that 1^* in B is the centre pixel and A^c denotes complement of A. [16M]

A =

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

B =

1	1	1
1	1^*	1
1	1	1

(CO4) [Application]

10. (a) Histogram Equalization is a computer image processing technique used to improve contrast in images. It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image. Apply the concept to achieve the Histogram equalization for the image given below. [14M]

53	52	54	55
75	57	58	25
35	51	25	37
55	25	65	66

- (b) Bit plane slicing is a method of representing an image with one or more bits of the byte used for each pixel. One can use only MSB to represent the pixel, which reduces the original gray level to a binary image. The three main goals of bit plane slicing are converting a gray level image to a binary image, representing an image with fewer bits and enhancing the image by focussing. Apply the concept of Bit plane slicing to the image given below and obtain any three bit planes. [6M]

10	11	4	1
6	9	10	12
8	9	2	14
6	4	0	9

(CO2) [Application]