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**PRESIDENCY UNIVERSITY  
BENGALURU**

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

**Semester :** Semester VI - 2020

**Course Code :** ECE3029

**Course Name :** Sem VI - ECE3029 - Digital Image Processing

**Program :** ECE

**Date :** 14-JUN-2023

**Time :** 9.30AM - 12.30PM

**Max Marks :** 100

**Weightage :** 50%

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**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. The total number of bits in an image depends upon the type of the image used. Find the total number of bits in 256x256 binary image.

(CO1) [Knowledge]
2. Compression ratio and Redundancy are the two important parameters widely used in Image compression. If, in 256 x 256 image, the number of bits/pixel before and after the image compression are 8 and 5 respectively, find the Compression ratio.

(CO3) [Knowledge]
3. Colour is a powerful descriptor that greatly simplifies object segmentation and identification. If RGB is given as (1, 0, 1), then find the values of CMY.

(CO4) [Knowledge]
4. A bit plane of an image is a set of bits corresponding to a given bit position in each of the binary numbers representing the signal. Briefly discuss the significance of bit plane slicing in digital image processing.

(CO2) [Knowledge]
5. Image segmentation can be carried out based on discontinuities and similarities. If  $z_i$  is the gray level of the pixel and  $w_i$  is the mask coefficient, then based on discontinuities, write an algorithm to detect a point in an NxN image.

(CO3) [Knowledge]

**PART B**

**ANSWER ALL THE QUESTIONS**

**(2 X 15 = 30M)**

6. (a) 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** 7, 7, 4, 3, 2, 1, 0, 0, 0, 10, 0, 0, 0, 0, 1, 10, 1, 0, 0, 0, 0, 5, 5, 5, 5

[8M]

- (b) 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) D is a distance function or metric used to define the relationship between pixels in a given image. Compute Euclidean distance, City Block distance, Chess Board distance and Dm distance between the pixels p and q marked in **Bold** in the image segment given below. Consider  $V = \{ 1, 2 \}$

[8M]

3	1	2	<b>1</b>	q
2	2	0	2	
1	2	1	1	
<b>1</b>	p	0	1	2

- (b) By applying Inverse Transformation, the original Image can be obtained using the Transformation coefficient Matrix. For a Given Input Image: U and the Orthogonal Transformation matrix: A, Compute Transformed image V and obtain the basis images.

$U = [2 \ 3; 1 \ 2]; A = [0.866 \ 0.5; -0.5 \ 0.866]$

[7M]

(CO1,CO2) [Comprehension]

**PART C**

**ANSWER ALL THE QUESTIONS**

**(3 X 20 = 60M)**

8. The methods used to compress image files typically fall into one of two categories: lossy and lossless. 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 0.5, 0.3, 0.2, 0.2, 0.2, 0.06, 0.06

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

(CO3) [Application]

9. a) If the Gray Scale Images are mapped with different colours, it helps the user to analyze the image better. 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) To shrink and expand the image, Morphological image processing algorithms are applied. Erosion and Dilation are the two popularly used algorithms for this purpose. 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	1	1
0	1	1	0	1	1	1	0
0	1	1	0	1	1	1	0
0	1	1	1	1	1	0	0
0	1	1	1	1	1	0	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]

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

- (b) 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]

1	2	3	4
5	6	7	8
1	2	3	4
5	6	7	8

(CO2) [Application]