Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - MAY 2023

Semester : Semester IV& VI - B.Tech ECE - 2021
Course Code : ECE3029
Course Name : Sem IV - ECE3029 - Digital Image Processing
Program : B.Tech. Electronics and Communication Engineering

Date : 18-MAY-2023
Time : 2.00 PM - 3.30 PM
Max Marks : 60
Weightage : 30%

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.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. Orthogonal functions are very much useful in image processing. Consider the functions $\sin \omega t$ and $\sin 2\omega t$. These functions are said to be Ortogonal if they satisfy a condition. Mention the condition for these functions to be Orthogonal.

(CO2) [Knowledge]

2. Given an X-**bit** per pixel **image**, **slicing** the **image** at different **planes** (**bit**-**planes**) plays an important role in **image processing**. In bit plane slicing, a 512 level gray scale image will have how many number of 1-bit planes

(CO2) [Knowledge]

3. Image Sensing and Acquisition is an important part in processing an image. How does it relate to illumination and reflectance.

(CO1) [Knowledge]

4. Set theory is the mathematical theory of well-determined collections, called sets, of objects that are called members, or elements, of the set. If “R” is the entire region of the image then what is the Union of all segmented parts.

(CO1) [Knowledge]

5. The number of bits required to store an image of size MXN is b=MxNxK where K is the number of bits per pixel. Determine the value of K if the image is a color image.

(CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 15 = 30M)**

6. Image Transformation represents a given Image as a Series Summation of a Set of Unitary Matrices/ Orthogonal Basis Images. 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 Trnsformed image V and obtain U using V and basis images. Also, Check if A is a Unitary matrix or not.
U= [3 1; -1 3]; A= [2 3; 1 2]

(CO2) [Comprehension]

7. If H is a general operator, that operates on a input image f(x,y) to produce an output image g(x,y), then H is said to be a Linear Operator if it satisfies Additive property and Homogeneity Property, where H[f(x,y)]=g(x,y).
a) Describe additive and homogeneity if f1(x,y) and f2(x,y) are the sub images of f(x,y) [3M]
b) Considering F1=[0 2 7; 2 3 9], F2=[6 5 0; 4 7 2] with a1=1 and a2= -1 for the Operator H=MEDIAN, Verify whether the operator is Linearity/Non-Linearity of the Operator. [4M]
c) Repeat the above problem for the operator H=∑(summation) [4M]
d) Consider an image of size 256 x 256. Compute the number of bits required if it is a Binary image, Gray scale image, Colour image. [4M]

(CO1) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION **(1 X 20 = 20M)**

8. a) In digital x-rays in which colors achieved are a palette of whites and blacks, different types of colors give the physician an idea of the type of density that he/she is observing. Therefore white structures are likely to indicate bone or water and black structures represent air. When pathologies are present in an image, trying to delimit the area of the lesion or object of interest may be a challenge, because different structures are usually layered one over the other. For example, in the case of the chest the heart, lungs, and blood vessels are so close together that contrast is critical for achieving an accurate diagnosis.Hence Histogram equalization is a straightforward image-processing technique often used to achieve better quality images in black and white color scales in medical applications. Suppose a 3bit image (L=8) of size 64X64 pixels (M*N=4096)has intensity distribution as shown in following table below, get histogram equalization transformation function.

Note: Approximate the result obtained during simplification to only 2 decimal places. [13M]

Gray level (rk)	0	1	2	3	4	5	6	7
No. of pixels (pk)	790	1023	850	656	329	245	122	81

b) Bit Plane Slicing (BPS) is a method of expressing an image in which each pixel is represented by one or more bits of the byte. To incorporate hidden data in any slice of eight slices, the BPS approach requires a bit slicing algorithm. Each pixel is represented by 8 bits in this approach. Apply this concept to the image given below to explore all the bit planes. [7M]

12	10	7	9
4	1	11	10
8	4	2	6
14	6	0	9

(CO2) [Application]