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B.TECH. VI SEM MAIN/BACK EXAM AUGUST 2023

COMPUTER SCIENCE AND ENGINEERING

(6CS3-01) - DIGITAL IMAGE PROCESSING

COMMON TO CSE,IT, AI, DS, MLC, CSE (AI & ML), CSE (DS), AI & ML, AI & DS

Time : 2 Hours]

[Max. Marks : 80

[Min. Passing Marks :

Instructions to Candidates : Part – A : Short answer type questions (up to 25 words) 5 × 2 marks = 10 marks. All FIVE questions are compulsory.

Part – B: Analytical/Problem Solving questions 4 × 10 marks = 40 marks. Candidates have to answer 4 questions out of 6.

Part – C: Descriptive/Analytical/Problem Solving questions 2 × 15 marks = 30 marks. Candidates have to answer 2 questions out of 3.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1_____ 2_____

PART A

1. Explain the effect of setting to zero the half of lower order bit planes have on the histogram of an image in general ?

2. Let us consider an image of size 8 inches × 8 inches. The resolution of an image is 100 dpi. Calculate total number of pixels available in a image ?

3. Consider a one-dimensional image f(x) = [60 60 60 100 100 100]. What are the first and second derivatives ?

4. What is the difference between image enhancement and image restoration ?

5. What is meant by noise modeling ? How is salt and pepper noise different from Gaussian noise ?

PART B

1. Show that bit plane slicing of the following image :

7	6	5
4	3	2
1	1	0

2. Consider the following two 8 bit images. Perform the following operations of these images

(a) Addition (b) element wise multiplication (c) negative of the image :

a

10	20	56
52	7	102
61	77	10

b

14	13	10
2	8	7
6	4	3

3. Show that the Fourier transform of the 2-D continuous function :

$$f(x, y) = A\cos(u_0 x + v_0 y)$$

Is the pair of conjugate impulses ?

$$F(u, v) = -\frac{A}{2}\left[\partial\left(u - \frac{u_0}{2\pi}, v - \frac{v_0}{2\pi}\right) + \partial\left(u - \frac{u_0}{2\pi}, v + \frac{v_0}{2\pi}\right)\right]$$

4. Consider the following two 8 bit images. Perform the follwing operations of these images

(a) Addition (b) element wise multiplication (c) negative of the images :

a

10	20	56
52	7	102
61	77	10

b

14	13	10
2	8	7
6	4	3

5. Determine the CIE chromaticity coordinates of a point given $C_1 = (0.14, 0.4, 2)$ and $C_2 = (0.51, 0.6, 1)$. Find the third color C_3.

6. Consider an image :

1	2	5
5	5	5
5	3	2

Show that output of any edge detection algorithm.

PART C

1. Show that the DFT of the discrete function $f(x, y) = \cos(2\pi u_0 x + 2\pi v_0 y)$ is :

$$F(u, v) = \frac{1}{2}\left[\partial(u + Mu_0, v + Nv_0) + \partial(u - Mu_0, v - Nv_0\right]$$

2. Prove that validity of the following properties of frequency and special domain. Prove any five out of 10. $5 \times 3 = 15$

(a) $f(x, y)$ real $\Leftrightarrow F^*(u, v) = F(-u, -v)$

(b) $f^*(x, y)$ complex $\Leftrightarrow F^*(-u, -v)$ complex

(c) $f(x, y)$ imaginary and odd $\Leftrightarrow F(u, v)$ real and odd

(d) $f(x, y)$ real $\Leftrightarrow R(u, v)$ even; $I(u, v)$ odd

(e) $f(-x, -y)$ complex $\Leftrightarrow F(-u, -v)$ Complex

(f) $f(x, y)$ real and odd $\Leftrightarrow F(u, v)$ imaginary and odd

(g) $f(x, y)$ imaginary and even $\Leftrightarrow F(u, v)$ imaginary and even

(h) $f(x, y)$ complex and even $\Leftrightarrow F(u, v)$ complex and even

(i) $f(x, y)$ complex and odd $\Leftrightarrow F(u, v)$ complex and odd

(j) $f(x, y)$ imaginary $\Leftrightarrow F^*(-u, -v) = -F(u, v)$.

3. Consider the simple 4 × 4, 8 bit image :

21	21	95	95
21	21	95	95
21	21	95	95
21	21	95	95

(a) Compute the entropy of image

(b) Compress the image using Huffman coding

(c) Compute the Compression achieved and the effectiveness of the Huffman Coding.