Ex/PG/MTCT/T/212A/2024

M. TECH. COMP. TECH. SECOND YEAR FIRST SEMESTER EXAMINATION, 2024
IMAGE PROCESSING

Full Marks: 100 **Time: 3 hours**

Answer any five questions.

9	2	9	6	1
1	9	1	6	2
9	2	6	1	6
6	4	6	1	2
2	6	1	6	1

Fig. 1: 5x5 Gray Scale Image patch

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

Fig. 2: 5x5 Binary Image patch

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1. Given an 8-bit image patch and respective pixel values in Fig. 1, perform the following tasks:

   a) Apply a 5x5 median smoothing filter mask and calculate the response for pixel locations not in boundary.
   b) Apply the filter kernel given in Fig. 3 to calculate the filter response for the pixel locations not in boundary.

-1	0	0
-1	5	0
-1	-1	-1

Fig. 3: 3×3 Kernel

10 + 10

2. a) Given a 1-bit image patch and respective pixel values in Fig. 2, compute m-path(s) exist in that patch.
   b) Explain JPEG compression scheme with a block diagram.
   c) Establish a relationship between sampling and quality of an image.

6 + 10 + 4

3. a) Explain Gaussian lowpass filtering process. Draw diagrams to illustrate the "cross section" of this filter in the frequency domain.
b) Describe with the help of a block diagram filtering of an image in the frequency domain.
c) Explain the minimization of ringing effect in Butterworth and Gaussian filters.

6 + 10 + 4

4. a) Explain the basic concept of image segmentation.
b) Formulate the gradient operators for edge detection.
c) Why is the Gaussian function used in case of Laplacian operator for edge detection?

5 + 10 + 5

[Turn over

5. An image has gray levels ranging from 0 to 15. The histogram of the image is given below:

Graylevel	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Frequency	1197	27	43	330	21	24	56	378	0	21	4561	312	18	123	44	345

a) Apply histogram equalization and find corresponding table after equalization.
b) Find Huffman codes for gray scales 0 to 15.

(10 + 10)

6.a) A source emits five symbols {a, b, c, d, e} with the probabilities 0.4, 0.2, 0.1, 0.1, and 0.2 respectively. Construct arithmetic coding to encode the word "daeecc"
b) Illustrate the model of the image degradation/restoration process. Explain, with examples, the role of noise PDFs in finding noise in an image.

(10 + 10)

7. a) A 8 inch by 10 inch color photograph is scanned at 200 dpi. The RGB components of each pixel are encoded with 24 bits. How many bytes are required to store the file?
b) A surveillance camera captures 640 by 480 images and sends them over a 14.4 kbit modem. Each pixel is digitized with 8 bits. How many frames per second are sent? We would like to have a throughput of at least 1 frame per second. Is compression needed? How much?
c) A source produces N equiprobable symbols. Find a formula for the entropy.

6 + 10 + 4

8. Write short notes on:
a) Structuring elements
b) Fuzzy Image Processing
c) Gamma correction
d) Coding redundancy
e) Sobel operator

(5 × 4)