2023

COMPUTER SCIENCE

Paper : CSME-301

(Image Processing and Pattern Recognition)

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer *question no.* **1**, *question no.* **2** and *any four* questions from the rest.

1. Answer *any five* questions : 2×5

   (a) How does the Weber Ratio affect the brightness of an image?

   (b) Perform shear (vertical) and shear (horizontal) transformations on the following matrix:

1	3	1	3
2	4	6	1
2	6	5	3
5	3	4	2

   (c) What is the impact of gamma in gamma transformation used in image enhancement?

   (d) Calculate the aspect ratio of an image of dimension 1920 × 1080.

   (e) What is the gradient of an image? Give an example.

   (f) How does correlation differ from convolution? Illustrate with an example.

   (g) Let p and q be the pixels at coordinates (10, 15) and (15, 25), respectively. Find out which distance gives the minimum distance between the pixels.

2. Answer *any five* questions : 4×5

   (a) How can you differentiate between intensity resolution and spatial resolution? How do these parameters affect the quality of the image?

   (b) If an image looks too dark or bleached out, then which transformation is used to make it more prominent? How will the appropriate correction be used?

   (c) What are the different noise models? Define each model with diagrams.

   (d) Image transmission is done in packets. A packet consists of a start bit, a byte of data, and a stop bit. Answer the following :

   (i) How many minutes would it take to transmit a 512×512 image with 256 gray levels at a 300 baud rate?

   (ii) What would be the time at the 9600 baud rate?

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(e) Suppose the RGB colour triplet for a particular colour is given by (0.3, 0.5, 0.2). Compute corresponding YIQ and HSV triplets.

(f) Compute the median value of the masked pixels shown below using a 3×3 mask.

18	22	33	25	32	24
34	128	24	17	26	33
22	19	32	31	28	26

3. (a) Write the application of sharpening filters.

(b) Consider the following image segment. Perform the following transformation on the shaded, pixels :
3+7

    (i) Image negative

    (ii) Log

    (iii) Gamma correction

    (iv) Contrast stretching in [0, 8]

    (v) Segmentation using mean intensity threshold.

15	6	21	22
17	15	6	19
14	3	11	12
19	14	19	16

4. (a) Discuss the process of region splitting and merging for region-based segmentation.

(b) Let A = {a / 20, b / 15, c / 5, d / 15, e / 45} be the alphabet and its frequency distribution. Draw the Huffman tree and then find the corresponding Huffman code from it.   4+6

5. (a) Write the algorithm for histogram specification.

(b) Plot the histogram of the following 8×8 image.

0	5	7	7	5	8	7	8
7	2	6	2	6	5	6	8
6	9	7	7	0	7	2	7
6	6	1	7	6	7	7	5
9	6	0	7	8	2	6	7
2	8	8	2	7	6	7	8
7	3	2	6	1	7	5	8
9	9	5	6	7	7	7	7

(c) Perform the histogram equalization of the image. Output the resultant image and its corresponding histogram.   3+2+5

6. Convert the following 3-bit RGB image to the CMY model.   10

1,2,5	4,1,5	5,4,2	2,1,4
3,6,5	4,1,3	6,6,1	5,4,1
2,1,4	3,1,4	4,2,3	1,4,3
3,2,1	3,1,3	1,1,2	2,3,1

7. (a) What are the steps of the Canny edge detector? Explain in detail.

(b) The following figure shows a 3-bit image of size 5-by-5 image in the square (with x and y coordinates specified) and a Laplacian filter .

Compute the output of the image with the 3×3 Laplacian filter shown above at the pixel (3, 3).   5+5

8. (a) Consider the following samples given below :

X1 = (0,0), X2 = (1,0), X3 = (0,1), X4 = (1,1), X5 = (2,1), X6 = (1,2), X7 = (2,2), X8 = (3,2), X9 = (6,6), X10 = (7,6), X11 = (8,6), X12 = (6,7), X13 = (7,7), X14 = (8,7), X15 = (9,7), X16 = (7,8), X17 = (8,8), X18 = (9,8), X19 = (8,9), and X20=(9,9).

Apply K-means algorithm to form clusters. Show all intermediate steps.

(b) What is the performance index used in the above procedure?

(c) What are the demerits of the K-means algorithm? Which method will you adopt to overcome the problem and how?   5+1+4