BE8-R4: DIGITAL IMAGE PROCESSING

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Explain sampling and quantization. Explain the effects of reducing sampling and quantization.
b) Give a 3 x 3 mask for performing unsharp masking in a single pass through an image.
c) What do you mean by pseudo and false coloring?
d) Give the formula for Gaussian lowpass filter for 2D and explain different variables in it.
e) List various components of image processing system.
f) Give three texture properties, which can be derived from first-order statistics.
g) Explain the homomorphic filtering.

(7x4)

2.

a) What do you mean by compression of an image? Compare lossless and lossy compressions with examples.
b) Illustrate the basic arithmetic coding process for the five symbol sequence a1a2a3a3a4. The probability of symbols is given as:

symbol	a1	a2	a3	a4
Probability	0.2	0.2	0.4	0.2

c) Consider the following symbols and their probability

symbol	a1	a2	a3	a4	a5	a6
Probability	0.1	0.4	0.06	0.1	0.04	0.3

Clearly explain the Huffman's code reduction and Huffman's code assignment process for given symbols. Also find the average length of this code.

(6+6+6)

3.

a) Give RGB color model. Discuss the conversion of RGB color space onto YCrCb space.
b) Show that the saturation component of a color image cannot be computed from saturation component of Input image alone.
c) Explain briefly the sharpening filters.

(6+6+6)

4.

a) 'Weiner filtering is an optimal trade off between inverse filtering and noise smoothing.' Explain.
b) Explain Stereo imaging with derivation to get depth information.
c) What is gray-level interpolation? Give one scheme for gray-level interpolation.

(8+4+6)

5.

a) Write short notes on:
   i) Image fusion
   ii) Multilevel thresholding

b) The following figure shows
   i) a 3-bit image of size 5-by-5 image in the square, with x and y coordinates specified,
   ii) a Laplacian filter and
   iii) a low-pass filter

y \ x	0	1	2	3	4
0	3	7	6	2	0
1	2	4	6	1	1
2	4	7	2	5	4
3	3	0	6	2	1
4	5	7	5	1	2

Figure-i

Laplacian filter

$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

Figure-ii

Low pass filter

$$\begin{pmatrix} 0.01 & 0.1 & 0.01 \\ 0.10 & 0.56 & 0.10 \\ 0.01 & 0.1 & 0.01 \end{pmatrix}$$

Figure-iii

Compute the following:
   i) The output of a 3 × 3 mean filter at (2, 2).
   ii) The output of a 3 × 3 median filter at (2, 2).
   iii) The output of the 3 × 3 Laplacian filter shown above at (2, 2).
   iv) The output of the 3 × 3 low-pass filter shown above at (2, 2)

(9+9)

6.

a) Show that the boundary of the region is a closed path.

b) In a given application an averaging mask is applied to input image to reduce noise, and then a Laplacian mask is applied to enhance small details. Would the result be same if the order of these operations were reversed? Explain your answer.

(9+9)

7.

a) Discuss different coding systems defined by JPEG standard.

b) Consider the image segment shown below. Let V={0,1}. Compute the length of the shortest 4-, 8- and m-path between p and q. If a particular path does not exist between these two points explain why.

$$\begin{matrix} \\ \\ \\ (p) \end{matrix} \begin{pmatrix} 3 & 1 & 2 & 1 \\ 2 & 2 & 0 & 2 \\ 1 & 2 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{pmatrix} (q)$$

c) Suppose that a digital image is subjected to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.

(8+5+5)