C7-R4: DIGITAL IMAGE PROCESSING AND COMPUTER VISION

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) Find the histogram equalization transformation function $P_s(s)$ for the probability density function $P_r(r)=-2r+2$.

b) The input matrix x(m,n) and h(m,n). Perfrom the linear convolution between these two matrices

$$x(m,n)=\begin{bmatrix}4 & 5 & 6\\ 7 & 8 & 9\end{bmatrix} \quad \text{h(m,n)}=\begin{bmatrix}1\\ 1\\ 1\end{bmatrix}$$

c) Perform LPF and HPF for the following image data

0	2	1
1	100	2
2	0	1

d) If we want to correlate two images of size 300 x 200 pixels how much should they be padded with zeros? And What does it mean if the correlation gives a maximum at: a) (0,0), (b) (10,10), c) (580,380);

e) Indicate the difference between the terms 'spatial resolution' and 'tonal resolution' in relation to an image.

f) A photograph is taken out of a side window of a car moving at a constant velocity of a 80Km/Hrs on a flat road. Why is it not possible to use an Inverse filter or Weiner filter in general to restore the blurring in this image.

g) In transform domain image compression, DCT is widely used than other transforms. Give two reasons for the popularity of DCT transform based image compression.

(7x4)

2.

a) Filter the following image using 3x3 neighborhood averaging by assuming (i) zero padding and (ii) pixel replication

$$\begin{bmatrix}1 & 2 & 3 & 2\\ 4 & 2 & 5 & 1\\ 1 & 2 & 6 & 3\\ 2 & 4 & 6 & 7\end{bmatrix}$$

b) Prove that for a unitary transform, the determinant has a unit magnitude and the Eigen values also have unit magnitude.

c) What is Walsh transform? Obtain a Walsh transform of 8x8 and its sequence. Discuss its advantages over Fourier transform.

(6+6+6)

3.

a) What is wavelet? Discuss clearly the features of wavelet transform and hence distinguish between continuous and discrete wavelet transforms.

b) Analyze a 3x3 mean filter in the frequency domain and prove that it behaves like a low pass filter.

(9+9)

4.

a) Describe briefly what is meant by an inverse filter and how it is related to the Wiener filter.

b) In the table below a three-symbol source with their probabilities are given.

Symbol	***Probability***
s_1	0.8
s_2	0.02
s_3	0.18

i) Determine the codeword to be assigned to each of the three symbols using Huffman coding.

ii) Determine the entropy, the redundancy and the coding efficiency of the Huffman code obtain in (i)

iii) By observing the above measurements, explain why in this case the extended Huffman code is expected to be more efficient than the conventional Huffman code. Justify your answer without determining the extended Huffman code. What disadvantages, if any, does the extended Huffman code have?

(6+12)

5.

a) Give the differences between average filter and median filter.

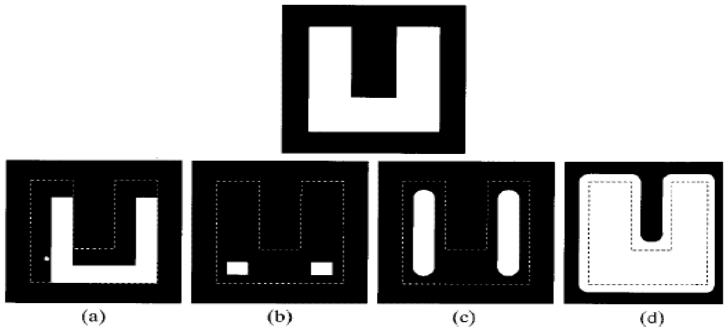
b) Give examples of 3×3 Prewitt, Sobel and Laplacian spatial masks that approximate local first derivative operators and compare the results arising from their use.

(6+12)

6.

a) Distinguish between image segmentation based on thresholding with image segmentation based on region growing technique.

b) Give the structuring element and morphological operation(s) that produced each of the results shown in images (a) through (d). Show the origin of each structuring element clearly. The dashed lines show the boundary of the original set and are included only for reference. Note that in (d) all corners are rounded.



(6+12)

7. Write short note on any **three** of the following:

a) Snakes and actice contours

b) Motion, estimation and tracking

c) Skeltonization and prunning

d) JPEG

(3x6)