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) Calculate the number of multiplication required to convolve a 2D filter with a 2D image. Assume the image is of the size 100 x 100 pixels, and the filter is of size 10 x10.

b) Compute the 2D DFT of the 4 x 4 gray scale image given as

$$I(m,n)=\begin{bmatrix}1\;1\;1\;1\\1\;1\;1\;1\\1\;1\;1\;1\\1\;1\;1\;1\end{bmatrix}$$

c) Let V=[0 1], compute D_4, D_8 and D_m distances between p and q.

$$\begin{bmatrix}1\,(q) & 1 & 2 & 3 \\ 0 & 2 & 2 & 1 \\ 1 & 1 & 0 & 2 \\ 2 & 1 & 2 & 1\,(p)\end{bmatrix}$$

d) Obtain the image negative of the following 8 bits per pixel image.

121	205	217	156	151
139	127	157	117	125
252	117	236	138	142
227	182	178	197	242
201	106	119	251	240

e) For the image shown below, compute the degree of compression that can be achieved using Huffman coding of pixel values?

$$\begin{bmatrix}3 & 3 & 3 & 2\\2 & 3 & 3 & 3\\3 & 2 & 2 & 2\\2 & 1 & 1 & 0\end{bmatrix}$$

f) Show that subtracting the Laplacian from an image is proportional to unsharp masking. Use the definition for the Laplacian in the discrete case?

g) Explain why do we lose details at the higher pyramid levels?

(7x4)

2.

a) Images generated by an electronic microscope are being inspected. In order to simplify the inspection task, digital image enhancement is used. When a representative set of images is examined, following problems are found:

i) Bright, isolated dots that are of no interest

ii) Lack of sharpness

iii) Not enough contrast in some images

iv) Shifts in the average grey-level value, when this value should be K to perform correctly certain intensity measurements.

Image enhancement will be used to correct all these problems. In addition, all grey levels in the band between I1 and I2 will be colored in constant red, while keeping normal tonality in the remaining grey levels. Propose a sequence of processing steps to achieve the desired goal.

b) Show that the application of a 3×3-sized local mean mask can be replaced by 1×3 and 3×1 masks applied sequentially. Compare the amount of additions that are needed in both cases.

(12+6)

3.

a) Depict the 3×3 Sobel gradient masks. Show for one of the Sobel masks that it can be separated as above into two one-dimensional masks. Is it possible to separate the 3×3 discrete Laplace-operator?

b) What is Resolution? Differentiate between spatial resolution and tonal resolution.

c) Perform LPF & HPF for the following images:

0	2	1
1	100	2
2	0	1

(6+6+6)

4.

a) Describe the following:

i) Image Pyramids

ii) Multiresolution discrete wavelet transforms

iii) Scaling functions

b) The 4 x4 input image is defined by the following matrix with gray scale [0 9].

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

Draw the image histogram and show the new output image along with its histogram equalization.

(9+9)

5.

a) What is the difference between internal and external object representation.

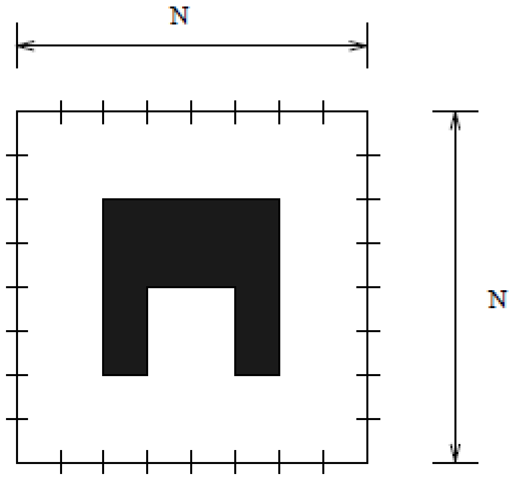
b) Enlist six differences between median filter and mean filter.

c) Explain about color transformations in image processing.

(6+6+6)

6.

a) Segment the image shown below using the split and merge procedure. Let P(R1)=TRUE if all pixels in R1 have the same intensity. Show the quadtree corresponding to your segmentation.



b) What do you mean by the shape number? And explain the topological descriptors in brief.

c) Explain about basic adaptive thresholding process used in image segmentation.

(6+6+6)

7.

a) Calculate the entropy of the image given by $I(m,n)=\begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 1 & 2 & 2\\ 0 & 1 & 2 & 3\\ 1 & 2 & 2 & 3\end{bmatrix}$.

b) Write brief notes on inverse filtering**.** Comment on its limitations

c) Compute the Haar transform T=HFH^T of the 2 x 2 image $F=\begin{bmatrix}3 & -1\\ 6 & 2\end{bmatrix}$. Also compute the inverse Haar transform F=H^{T}TH of the desired result.

(6+6+6)