C7-R4: DIGITAL IMAGE PROCESSING & 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) Plot the histograms of Dark, light, High Contrast and Low Contrast Images.

b) What is optical illusion? Draw any 3 optical illusions.

c) Compare HSV and HSL Color model.

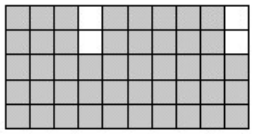
d) Let *I* be an image of size 3x3 with following pixel values. Let each bit of *I* be represented using 4 bits. Give the bit-plane coding for image *I*.

$$I = \begin{bmatrix} 8 & 10 & 9 \\ 4 & 1 & 0 \\ 6 & 7 & 2 \end{bmatrix}$$

e) Performance of a lossy compression technique is based on error criterion. Which are the commonly used objective error criterions?

f) Consider an 8-pixel line of intensity data {108, 139,135,244,172,173,56,99}. If it is uniformly quantized with 4 bit accuracy, compute the rms error and rms signal to noise ratio for the quantized data

g) Describe Boundary Extraction .Perform boundary extraction on the below given figure.



(7x4)

2.

a) Linear filtering of an image is accomplished through an operation called *convolution*. Perform convolution on the given image.

```
A = [17  24   1  8  15
     23   5   7  14  16
      4   6  13  20  22
     10  12  19  21   3
     11  18  25   2   9]
```

and the convolution kernel is

```
h = [8   1   6
     3   5   7
     4   9   2]
```

b) Explain the steps for filtering in the frequency domain.

c) A general gray-level transform can be described as $y = f(x)$ where x is the original pixel value and y is the result after transform. Describe Constant addition and negation transformation.

(8+6+4)

3.

a) Explain the procedure for Otsu's method of Image Segmentation.

b) Define Projective Geometry. Explain its significance in Computer Vision.

c) Image acquisition and image transmission are two important processes. These two processes are the two principle sources of noise. Describe noise effect of image acquisition by imaging sensors.

(8+6+4)

4.

a) Construct a fully populated approximation pyramid and corresponding prediction residual pyramid for the image

$$F(x,y) = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{pmatrix}$$

Use 2x2 block neighborhood averaging for the approximation filter and assume interpolation filter implements pixel replication

b) Write a short note on Median Filtering.

c) What do you mean by adaptive filters? Explain working of Adaptive-Median Filter with suitable equations.

(6+6+6)

5.

a) Write short-note on Variable Length Coding. Generate Huffman Code

Symbol	A1	A2	A3	A4	A5	A6
Probability	0.1	0.4	0.06	0.1	0.04	0.3

b) Give various Definitions of Computer Vision.

(9+9)

6.

a) Define properties of Fast Fourier Transform.

b) Explain Marr-Hildreth Edge Detection and derive equation for Laplacian of Gaussian (LoG).

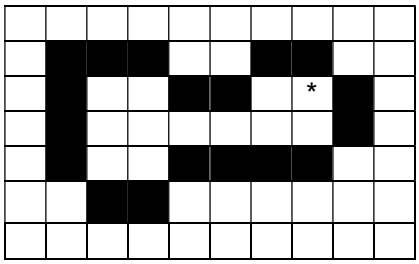
c) Consider Pr(r)= - 7r+2. Using the given PDF, show that the histogram equalization yields always uniform PDF.

(6+6+6)

7.

a) Explain Hit-or-Miss Transform.

b) Explain the steps of Hole filling with neat diagrams for the below given image, where * indicate the position to begin the hole filling process.



(9+9)