

CE5-R3: IMAGE PROCESSING AND COMPUTER VISION

NOTE:

1. Answer question 1 and any FOUR questions from 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 with example additive and subtractive color models.
- b) What do you mean by zero crossing in edge detection?
- c) Write down the formulae to compute Discrete Fourier Transform and its inverse of a discrete 1-D signal. Explain the various terms used in the formulae.
- d) Discuss Hough transform for line detection.
- e) Name two morphological operations and explain them with examples.
- f) If gray levels in an image range from 0 to 255, how many bits will be required to represent a pixel? What will be the size of a 100x100 image in bytes?
- g) Write a procedure to stretch contrast of an image.

(7x4)

2.

- a) Discuss various types of Arithmetic and logical operations that can be performed on digital images with their applications.
- b) Give linear filter masks for the following operations:
 - i) Region averaging
 - ii) Weighted region averaging (pixels near center should be given more weight)
- c) What is connected component in an image? Describe one approach for finding connected components.

(6+6+6)

3.

- a) What is an edge? Explain with an example.
- b) A Sobel operator uses two masks, H_x and H_y to process the image for edge detection. Explain what is measured by these masks and why two masks are required.
- c) What is the meaning of a linear operator? Is Sobel a linear operator? Give justification for your answer.

(6+6+6)

4.

- a) An image array $p(m, n)$ of size $M_1 \times N_1$ is to be convolved with a filter array $q(m, n)$ of size $M_2 \times N_2$ to produce a new image array $s(m, n)$. Write a pseudo code program that describe a method to compute $s(m, n)$ through the use of Fourier transforms. The result should be the same size as would be achieved with direct convolution.
- b) Find the results of applying Robert's edge operator to the following image matrix. For the result, you can neglect top row and left column.

5	7	4	3
4	0	0	0
6	1	2	1

(10+8)

- 5.
- What is histogram of an image? Explain histogram equalization.
 - What are the different types of features that can be seen from the histogram of a grayscale image?
 - Consider a grayscale I image whose grayscale values $I(r, c)$ of r^{th} row and c^{th} column is lying between 0 and 255. Let, for the range of all gray level values from 30 to 75, we want to stretch the range from 45 to 255. Obtain the equation for such type of stretching.
- (6+6+6)**

- 6.
- Laplacian mask is defined as follows. Derive this mask using finite differences

0	-1	0
-1	4	-1
0	-1	0

- What are the three basic redundancies that can be identified in digital images? How can these redundancies be eliminated?
 - Discuss JPEG and DCT-based image compression standards.
 - How the "salt and pepper" noise look like? How can it be removed?
- (6+4+4+4)**

- 7.
- Define boundary descriptor. Plot the signature of the following boundaries:
 - An equilateral triangle
 - A rectangle
 - What do you mean by image segmentation? Discuss one image segmentation technique.
 - Discuss following terms
 - Epipolar line
 - Shape from motion
- (6+6+6)**