

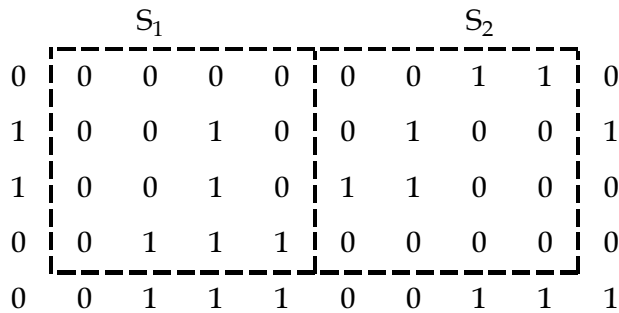
**C7-R4 : DIGITAL IMAGE PROCESSING AND COMPUTER VISION**

**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 diagram, perspective projection.  
 (b) Differentiate Sampling and Quantization techniques used in image processing.  
 (c) Consider the two image subsets, S1 and S2, shown in the following figure. For  $V = \{1\}$ , determine whether these two subsets are :  
 (i) 4-adjacent, (ii) 8-adjacent, or (iii) m-adjacent.



- (d) Find the number of bits to store a  $512 \times 512$  image with 128 gray levels.  
 (e) What is blind spot. How is it connected with the rods and cones in human eye.  
 (f) Perform Histogram matching for an image based on specific image given below :

Given image

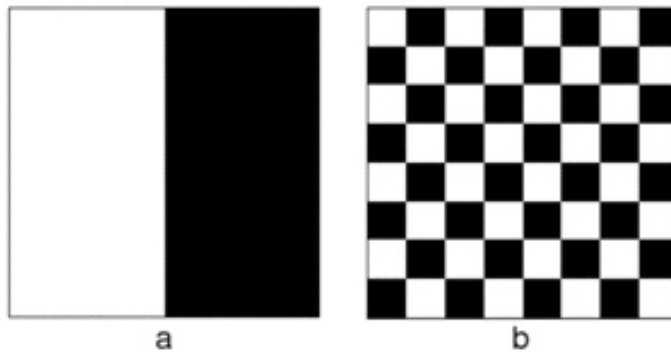
Gray Level	0	1	2	3	4	5	6	7
No of Pixels	790	1023	850	656	329	245	122	81

Specific image

Gray Level	0	1	2	3	4	5	6	7
No of Pixels	0	0	0	614	819	1230	819	614

- (g) Differentiate Fourier transform and wavelet transform. (7x4)

2. (a) Give a geometric construction of the image  $P'$  of a point  $P$  given the two focal points  $F$  and  $F'$  of a thin lens.
- (b) Show that rotation matrices are characterized by the following properties :
- (i) the inverse of a rotation matrix is its transpose and
- (ii) its determinant is 1
- (c) Define edge detection. What are the different edge detection techniques used in image processing ? (6+6+6)
3. (a) Discuss the region-based segmentation algorithm used to divide an image into regions.
- (b) State & prove the convolution property of Fourier Transform.
- (c) Explain gaussian filter with its proper working. (6+6+6)
4. (a) Explain the following morphological operations :
- (i) Hit and Miss transformations
- (ii) Opening and Closing
- (b) What do you mean by color image processing. Explain different color models used in it.
- (c) The two texture images shown below are quite different, but their histograms are identical. Both images have size  $80 \times 80$ , with black (0) and white (1) pixels. Suppose that both images are blurred with a  $3 \times 3$  smoothing mask.
- (i) Would the resultant histograms still be the same ?
- (ii) If answer is no, either sketch the two histograms or give two table detailing the histogram component.



(6+6+6)

5. (a) Define Image Enhancement. Explain the following Enhancement operations :
- (i) Bit Plane Slicing
  - (ii) Grey Level Slicing
- (b) Show that the Laplacian defined as in Equation below is isotropic (rotation invariant).

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

Use following equations to prove this.

$$x = x' \cos\theta - y' \sin\theta$$

$$y = x' \sin\theta - y' \cos\theta$$

Where  $\theta$  is the angle of rotation.

**(8+10)**

6. (a) A file contains the following characters with the frequencies as shown in table below. If Huffman Coding is used for data compression, determine :
- (i) Huffman Code for each character
  - (ii) Average code length
  - (iii) Length of Huffman encoded message (in bits)

Characters	Frequencies
a	10
e	15
i	12
o	3
u	4
s	13
t	1

- (b) What is Haar Transformation. Compute Haar Transform for N=8. **(12+6)**

7. (a) Explain all the fundamental steps of digital image processing with suitable diagram.
- (b) Why DCT is preferred over DFT for image compression ?
- (c) Describe active contour "Snakes" used to estimate the object boundary. Write only the energy function of it. **(10+4+4)**

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