IMAGE PROCESSING
(CSEN 4262)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i)   A function d(p,q) be the distance function between pixels p and q. Then
         (a) $d(p,q) = d(q,p)$ (b) $d(p,q) + d(q,p) = 0$
         (c) $d(p,q) + d(q,p) = 1$ (d) $d(p,q) - d(q,p) = 1$.

   (ii) The total amount of energy that flows from the energy source (light etc.) and is usually measured in watts is called
         (a) radiance   (b) luminance
         (c) reflectance   (d) none of these.

   (iii) Segmentation is a process that partitions image into
         (a) regions   (b) pixels
         (c) vertices   (d) none of the above.

   (iv) An image of size 1024 × 1024 pixels in which the intensity of each pixel is an 8 bit quantity requires the storage space (if not compressed)
         (a) 1 KB   (b) 1 MB   (c) 2 KB   (d) 2 MB.

   (v)   Digitizing the intensity value of an image is called
         (a) quantization   (b) sampling
         (c) segmentation   (d) compression.

   (vi) In 8-distance measurement system distance between centre pixel and a corner pixel is
         (a) 2 unit   (b) $\sqrt{2}$ unit   (c) 1 unit   (d) 1.5 unit.

   (vii) The D8 distance (chessboard distance) between p and q with coordinates (x, y) and (s, t) is defined as
         (a) $D8(p,q) = |x-s| + |y-t|$ (b) $D8(p,q) = \max(|x-s|, |y-t|)$
         (c) $D8(p,q) = [(x-s)^2 + (y-t)^2]^{1/2}$ (d) none of these.

   (viii) Smoothing in frequency domain is achieved by
         (a) homomorphic filter   (b) low-pass filter
         (c) Wiener filter   (d) high–pass filter.

   (ix) Image segmentation technique is based
         (a) discontinuity of intensities
         (b) similarity of intensities (Region based)
         (c) both (a) and (b)
         (d) none of these.

   (x)   Median filter is used to remove:
         (a) salt-and-pepper noise   (b) speckle noise
         (c) periodic noise   (d) Gaussian noise.

Group – B

2. (a) What is suitable data structure for digital image representation? Briefly discuss image acquisition technique using sensor array.

   (b) What are translation, scaling, rotation matrices for image transformation?

   (c) Explain the process of sampling and quantization.
                                            (1 + 3) + 5 + 3 = 12

3. (a) Write some properties of two dimensional discrete Fourier transform. What are the applications of this transform?

   (b) What do you mean by arithmetic operations on an image? Explain.

   (c) Define 8-adjacency of pixels in a gray scale image.
                                            (3 + 2) + 5 + 2 = 12

Group – C

4. (a) What is histogram? Can two different images have the same histogram? Justify your answer.

   (b) Perform histogram equalization of the following image:

4	4	4	4	4
3	4	5	4	3
3	5	5	5	3
3	4	5	4	3
4	4	4	4	4

   (c) What do you mean by thresholding and clipping? Give suitable example.
                                            (1.5 + 1.5) + 5 + (2 + 2) = 12

5. (a) What is high-boost filter that is used in spatial domain for image sharpening? How does it work?

   (b) Explain Homomorphic filtering.

   6 + 6 = 12

Group – D

6. (a) When the only degradation present in an image is noise, then what is the equation that describes the degraded image in spatial domain? Describe each component of the equation.

   (b) Explain how an arithmetic mean filter can be used to reduce noise in an image.

   (c) How is transfer function of a band pass filter obtained from corresponding transfer function of band reject filter? Explain how a band reject filter can be used to restore an image that is corrupted by sinusoidal noise.

   3 + 3 + (2 + 4) = 12

7. (a) State the types of data redundancies suffered by two dimensional intensity arrays.

   (b) Prove that entropy is maximum when the symbols are equiprobable. Calculate the efficiency of Huffman code for the following symbol whose probability of occurrence is given below:

Symbol	Probability
a1	0.9
a2	0.06
a3	0.02
a4	0.02

   4 + 4 + 4 = 12

Group – E

8. (a) What is a hit-or-miss transformation? What are the effects of the dilation and erosion process?

   (b) Explain the following morphological algorithms:
   (i) Boundary extraction
   (ii) Hole filling.

   (2 + 2) + (4 + 4) = 12

9. (a) Explain how Robert's operator and Sobel operator are used for edge detection and enhancing image.

   (b) What is Hough transform method of edge linking?

   (c) Describe the region growing technique for image segmentation. What is the problem associated with it?

   3 + 6 + 3 = 12