IMAGE PROCESSING
(INFO 4102)

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)   GIF image compression is a
   (a) lossy compression technique
   (b) lossless compression technique
   (c) combination of lossy and lossless compression technique
   (d) moderately lossy compression technique.

   (ii)   The maximum compression is achieved in
   (a) P frame   (b) B frame
   (c) I frame   (d) all will get same compression ratio.

   (iii)   If a 375×300 gray-scale image needs to be sent across the channel of capacity 28 kbps, then how much transmission time is required?
   (a) 52.14 sec   (b) 42.14 sec   (c) 32.14 sec   (d) 22.14 sec.

   (iv)   Image transformations in spatial domain are _____ operations.
   (a) logical   (b) fuzzy   (c) local   (d) global.

   (v)   D8 distance between p (x, y) and q (s, t) is defined as _____.
   (a) min(|x – s|, |y - t|)   (b) median(|x – s|, |y - t|)
   (c) mode(|x – s|, |y - t|)   (d) max(|x – s|, |y - t|).

   (vi)   How much memory is needed to store a 1024×1024 gray-scale image? (Assume 1Kb=1000 bytes)
   (a) 1049 Kb   (b) 1041 Kb   (c) 1045 Kb   (d) 1047Kb.

   (vii)   Salt and pepper noise can be removed by _____.
   (a) box filter   (b) median filter   (c) max filter   (d)min filter.

   (viii)   Which of the following is not a interpolation technique?
   (a) Gaussian   (b) Bicubic   (c) Bilinear   (d) Replication.

   (ix)   The difference between highest and lowest intensity levels in an image is called ____.
   (a) contrast   (b) brightness   (c) saturation   (d) gray level.

   (x)   Which of the following is used for finding +45 degree lines?

   a.

-1	-1	-1
2	2	2
-1	-1	-1

   b.

-1	2	-1
-1	2	-1
-1	2	-1

   c.

-1	-1	2
-1	2	-1
2	-1	-1

   d.

2	-1	-1
-1	2	-1
-1	-1	2

Group – B

2. (a)   What is the role of interpolation techniques in image processing?

   (b)   Consider an image $I = \begin{bmatrix} 0 & 1 & 1 \\ 2 & 0 & 3 \\ 1 & 0 & 2 \end{bmatrix}$ of size 3×3. Apply replication and nearest neighbour interpolation techniques to resize the image I to 6×6. Will the results be identical?

   3 + (3 +3 + 3) = 12

3. (a)   Explain the output of the following spatial masks on an image.

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

   Mask 1

-1	-1	-1
-1	8	-1
-1	-1	-1

   Mask 2

   (b)   Apply the histogram equalization technique to the following image.

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

   (3 + 3) + 6 = 12

Group – C

4. (a)   Compare the output of applying the order-statistic filters on the following image.

120	134	150	170	110
100	0	150	170	100
130	150	255	170	130
145	130	150	160	50
140	155	130	140	50

(b)   What is periodic noise? How can it be removed using band-pass filter?

3 × 3 + (1 + 2) = 12

5. (a)   Write the expression for
   i) 2D DFT and its inverse
   ii) Fourier spectrum
   iii) phase angle and power spectrum
(b)   Explain the different steps of filtering in the frequency domain.
(c)   Compare correlation and convolution operation in image processing.

6 + 3 + 3 = 12

Group – D

6. (a)   With proper block diagram, explain how JPEG compression loses image data permanently.
(b)   "Digitization of image is inherently a process of lossy compression" – justify.

(5 + 3) + 4 = 12

7. (a)   Consider the data:
   ABABAABA$ABAAC$ABABABAABA$ABAAC$AB
   Find out the compression ratio and compressed output string for this input string using RLE, Huffman encoding and LZW encoding techniques.

(b)   Compare between these compression techniques in this regard.
   How does quantization help in compression? What is vector quantization? Explain.

6+ (3 + 3) = 12

Group – E

8. (a)   Explain first and second order derivatives of an image.
(b)   Consider a 1-D image f(x) = [5, 5, 4, 3, 2, 1, 0, 0, 0, 6, 0, 0, 0, 0, 1, 3, 1, 0, 0, 0, 0, 7, 7, 7, 7]. Apply the first and second order derivatives and locate the position of edges.

3 + (3 + 3 + 3) = 12

9. (a)   What is an edge? Explain with an example.
(b)   Discuss the role of the Laplacian operator as an edge detector. What is the major shortcoming of the Laplacian operator?
(c)   How can you detect a line oriented around 45°?
(d)   What do you mean by zero crossing in edge detection?

(2 +1) + (3 + 2) + 2 +2 = 12