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 any 5 (five) from Group B to E, taking at least one 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) For an 8-bit image x[m,n,], the transform y[m,n] = 255 – x[m,n] will give
(a) dark image (b) bright image
(c) negative image (d) output same as input image.

(ii) An image function $f(x, y)$ is characterized by $f(x, y) = i(x, y)r(x, y)$ where
(a) $0 < i(x, y) < 1$ & $0 < r(x, y) < \infty$ (b) $0 < i(x, y) < 1$ & $0 < r(x, y) < 1$
(c) $0 < i(x, y) < \infty$ & $0 < r(x, y) < \infty$ (d) $0 < i(x, y) < \infty$ & $0 < r(x, y) < 1$

(iii) 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.

(iv) High pass filters are used for image
(a) contrast (b) sharpening
(c) blurring (d) resizing.

(v) The transition between continuous values of the image function and its digital equivalent is called
(a) Quantisation (b) Sampling
(c) Rasterisation (d) None of these.

(vi) The operator which detects edge in an image is
(a) logarithm (b) exponential
(c) gradient (d) average.

(vii) Which of the following is a lossy coding?
(a) Run-length coding
(b) Uniform quantiser
(c) Huffman coding
(d) Predictive coding without quantiser.

(viii) A pixel p at coordinates (x, y) has four horizontal and vertical neighbours whose coordinates are given by:
(a) $(x-1, y-1), (x-1, y), (x, y-1), (x, y+1)$
(b) $(x+1, y), (x-1, y), (x, y+1), (x, y-1)$
(c) $(x+1, y-1), (x-1, y), (x-1, y+1), (x, y+1)$
(d) $(x+1, y), (x+1, y-1), (x, y+1), (x-1, y+1)$.

(ix) Morphological Image Processing means
(a) DFT of image
(b) Histogram of image
(c) finding regions of image
(d) extracting meaningful image components.

(x) Region growing is a …… image segmentation approach
(a) Bottom-up (b) Top-Down
(c) Mixed approach (d) All the above.

Group – B

2. (a) What is the suitable data structure to represent a digital image? Briefly explain a simple image formation model.

(b) Define Euclidean distance, city block distance and chessboard distance. Let V = {0,1}. Compute D_e, D_4, D_8 distances between two pixels p and q. The coordinates of P and q are (3, 0) and (2, 3) respectively.

(c) Explain 1D convolution process with the help of a suitable example.

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

3. (a) When and where will you use non uniform sampling and quantization?

(b) How image can be zoomed by using replication and linear interpolation method? Explain with suitable example.

(c) State 3 properties of 2D discrete Fourier transform.
Prove that the unitary transform works for the given image.
$F = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and the given unitary transformation Kernel: $^1/_{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

2 + 4 + (3 + 3) = 12

Group – C

4. (a) If all the pixels in an image are shuffled, will there be any change in the histogram? Justify your answer.

(b) Write down the basic Hadamard transform for the matrix $H_{4,4}$. Prove that Hadamard transform works for the following image:
$F = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$

(c) What do you mean by gray level slicing with and without background? Give suitable example.

3 + (1 + 4) + (2 + 2) = 12

5. (a) Describe how filtering is done in the frequency domain (give all the steps from spatial domain to frequency domain and back). Why are ideal filters not used?

(b) Equalize the following histogram. Show the histogram before and after equalization.

Gray Level	0	1	2	3	4	5	6	7
Number of Pixels	10	20	12	8	0	0	0	0

What are the Histogram characteristics for dark and bright image?

(c) Write short note on Homomorphic Filtering.

(1 + 3) + (3 + 1) + 4 = 12

Group – D

6. (a) Explain the working principal of inverse filter. What are the advantages and drawbacks of inverse filter?

(b) When will Wiener filter reduce to an inverse filter? Explain.

(c) What is the role of quantisation matrix in JPEG compression?

(4 + 2) + 3 + 3 = 12

7. (a) Write down the encoding algorithm of LZW. Consider the string ADBB. Encode the string by using LZW algorithm.

(b) Assume a quantization threshold of 32 and derive the quantization error for each of the following DCT coefficients: 127,72,67,78,128,168.

(3 + 5) + 4 = 12

Group – E

8. (a) Explain dilation and erosion process with example?

(b) Explain Split and merge algorithm for segmentation.

(c) What is done in thinning and thickening operation?

(2 + 2) + 5 + 3 = 12

9. (a) Explain region growing algorithm with suitable example. What are the advantages / disadvantages if we use more than one seed in a region growing technique?

(b) Distinguish between image segmentation based on thresholding with image segmentation based on region-growing techniques. What are the main drawbacks of Laplacian operator for detecting edges of an image?

(6 + 2) + (2 + 2) = 12

Department & Section	Submission Link
CSE A + B + C	https://classroom.google.com/c/Mjk4NTk3Mzg4Nzk3/a/MzU2MzM0MDcyOTI4/details