Course code: **Ex/ET/PE/B/T/424/G/2024(S)**

B.ETCE 4TH YEAR 2ND SEMESTER SUPPLEMENTARY EXAMINATION

Digital Image Processing

Session 2023-24

Full Marks: 100. Total Time 3 Hours.

Part I Answer any 10 questions **(CO1) 10x2=20**

1. State the range of electromagnetic spectrum in the visible range.
2. What is bilinear interpolation with respect to digital images?
3. Give the expression for reversing the intensity levels of an image.
4. What is a box filter?
5. Give another name for impulse noise.
6. Define an isotropic filter.
7. State the equation showing the sifting property of a 2D impulse function located at coordinates (t_0, z_0).
8. What kind of components in an image represents low frequency components?
9. Give the expression for an image restored using a geometric mean filter.
10. The mean square error in Wiener filter is measured between which terms?
11. State the advantage of Huffman coding?
12. What is the run length coding scheme?
13. Why is an image 'smoothed' before the edge detection operation?
14. What is the gradient operator in segmentation method?
15. State Otsu's method.

Part II Answer any 3 questions **(CO2) 10x3=30**

1. Write an expression for 2D continuous convolution. Prove that both the 2 D continuous and discrete Fourier Transform are linear operations. 2+8

2. a) Laplacian mask with a -8 in the centre yields sharper image than the one with a -4 in the centre. Explain the result in detail. 5
   b) Clarify how this type of filtering behaves as a function of mask size. 5

3. Develop an algorithm for a nxn filter, showing the nature of the computations involved and the scanning sequence used for the mask around the image by moving the centre of

the mask throughout an image and, at each location, computing the sum of products of the mask coefficients with the corresponding pixels at that location. 10

4. Apply a mean filter and a max filter on the following image matrix. Use a 3x3 neighbourhood. Show the resulting image matrix. CO2

5	1	2	6	7
4	4	7	*5*	*8*
2	6	20	6	7
3	1	2	4	5
10	2	1	2	3

10

Part III Answer any 3 questions **(CO3) 10x3=30**

1. State the steps of Adaptive Median filter and explain how it works to remove noise. 10
2. (i)How many unique Huffman codes are there for a three-symbol source? Construct them. 2+3
   (ii) Encode arithmetically the sequence *bbadc* for a four-symbol source {a,b,c,d} with source probabilities {0.1,0.4,0.3,0.2}. 5
3. Illustrate variable-length coding procedures to be used for compression of a histogram equalized image with 2^n intensity levels. Also show how such an image containing spatial or temporal redundancies can be exploited for data compression. 5+5
4. Consider the simple 4x8, 8-bit image as given:

   21 21 21 95 169 243 243 243
   21 21 21 95 169 243 243 243
   21 21 21 95 169 243 243 243
   21 21 21 95 169 243 243 243

   a) Compute the entropy of the image.
   b) Compress the image using Huffman coding.
   c) Compute the compression achieved and the effectiveness of the Huffman coding. 3+3+4
5. Implement the LZW coding algorithm to encode the 7-bit ASCII string "aaaaaaaaaa". 10

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Part IV Answer any 2 questions **(CO4) 10x2=20**

1. Illustrate the role of the Sobel mask for detecting edges in an image. Hence show that the edges so detected are useful in image segmentation. 4+6

2. a) Write the Canny edge detector algorithm.
   b) Formulate Step I and the gradient magnitude image computation in Step II of the Canny algorithm using 1-D instead of 2-D convolutions.
   c) Demonstrate the computational advantages of using the 1-D convolution approach. 2+4+4

3. Restate the basic global thresholding algorithm so that it uses the histogram of an image instead of the image itself. 10