



End Semester Examination  
JANUARY 2024

Max. Marks: 100

Class: TE AIML-DS

Course Code: AI302

Name of the Course: Fundamentals of Signal & Image Processing (FoSIP)

Duration: 180 Min

Semester: V

Branch: CSE

Instruction:

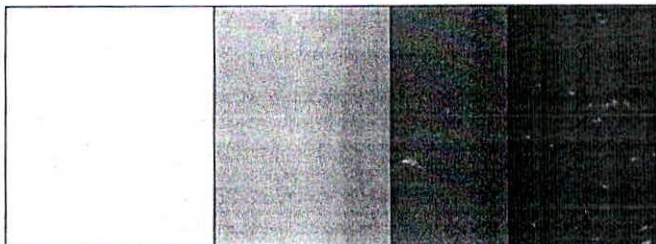
- (1) All questions are compulsory.
- (2) Use of scientific calculators is allowed.
- (3) Draw a neat diagram.
- (4) Assume suitable data if necessary with justification.

		Max. Mar ks	CO
Q.1	Attempt the following Short Answer Questions.		
(A)			
(1)	Determine whether the following signal is an energy signal or power signal? $x[n] = (1/3)^n u[n]$	1	CO 1
(2)	Determine the Cross Correlation of the following signals $x[n] = \{1, 4, 6, 3\}$ and $h[n] = \{7, 5, 8, 9\}$ .	1	CO 1
(3)	Convolution in the time domain is equivalent to which operation in the frequency domain? Why?	1	CO 1
(4)	Does DTFT give continuous spectra or discrete spectra? Why?	1	CO 1
(5)	If the discrete time signal is expanded in the time domain, what will be the effect in the frequency domain? Explain with the help of an equation.	1	CO 1
(6)	Choose the correct option: The transform which is widely used to detect 'lines' in an image is (a) Fourier transform (b) Hough transform (c) cosine transform (d) Haar transform	1	CO 1

(7)	<p>Choose the correct option:</p> <p>What does the definition of entropy tell us?</p> <p>(a) The lower bound to encode a source without distortion</p> <p>(b) The upper bound to encode a source without distortion</p> <p>(c) The average number of bits to encode a source without distortion</p> <p>(d) The average number of bits to encode a source given a certain distortion</p>	1	CO3																									
(8)	<p>Choose the correct option:</p> <p>Statement 1: A histogram gives the frequency of occurrence of the gray level.</p> <p>Statement 2: A histogram is invariant to rotation.</p> <p>(a) Statements 1 and 2 are wrong.</p> <p>(b) Statement 1 is correct and Statement 2 is wrong.</p> <p>(c) Statements 1 and 2 are correct.</p> <p>(d) Statement 2 is correct and Statement 1 is wrong.</p>	1	CO2																									
(9)	<p>Choose the correct option:</p> <p>Below are the pixel values in a <math>5 \times 5</math> gray-level image:</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td>1</td><td>2</td><td>3</td><td>1</td><td>2</td></tr> <tr><td>4</td><td>5</td><td>2</td><td>3</td><td>3</td></tr> <tr><td>3</td><td>3</td><td>5</td><td>4</td><td>4</td></tr> <tr><td>1</td><td>3</td><td>2</td><td>3</td><td>5</td></tr> <tr><td>2</td><td>1</td><td>3</td><td>1</td><td>3</td></tr> </table> <p>What will be the value of the marked pixel after applying a <math>3 \times 3</math> mode filter?</p> <p>(a) 2                      (b) 3                      (c) 4                      (d) 5</p>	1	2	3	1	2	4	5	2	3	3	3	3	5	4	4	1	3	2	3	5	2	1	3	1	3	1	CO2
1	2	3	1	2																								
4	5	2	3	3																								
3	3	5	4	4																								
1	3	2	3	5																								
2	1	3	1	3																								
(10)	<p>Choose the correct option:</p> <p>A five-symbol alphabet has the following probabilities <math>P(a) = 0.1</math>, <math>P(b) = 0.30</math>, <math>p(c) = 0.25</math>, <math>p(d) = 0.15</math> and <math>p(e) = 0.20</math>. The following codes are assigned to the symbols <math>a = 111</math>, <math>b = 0</math>, <math>c = 1</math>, <math>d = 001</math> and <math>e = 10</math>. The average code-word length for this source is</p> <p>(a) 1.7                      (b) 2                      (c) 1.8                      (d) 1.0</p>	1	CO3																									
Q.1 (B)	<p>Check for the following system is: i) Static or Dynamic, ii) Causal or Non-Causal, iii) Linear or Nonlinear, iv) Time Variant or Time Invariant, v) Stable or Unstable</p> <p>(a) <math>y(n) = 2x[n-1] + x[2n]</math></p> <p>(b) <math>y(n) = [x(n)]^n + x[n]</math></p>	10	CO1																									
Q.2 (A)	<p>Compute circular convolution using DFT-IDFT for the following sequences:</p> <p><math>x[n] = \{2, 3, 1, 1\}</math> and <math>h[n] = \{1, 3, 5, 3\}</math></p>	10	CO1																									



<b>Q.2</b> <b>(B)</b>	Find the DFT of a sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using radix-2 Decimation in Time Fast Fourier Transform (DIT-FFT) Algorithm.	10	CO1
<b>Q.3</b> <b>(A)</b>	<p>A <math>4 \times 4</math> grayscale image passes through three spatial linear shift-invariant filters, resulting in three filtered images. Compute the filtered image 1 and filtered image 3. Based on the relationship between filtered image 1, filtered image 2, and filtered image 3, determine the filter coefficients in the shift invariant linear filter 2.</p> <div style="text-align: center; margin: 20px 0;"> </div>	10	CO2
<b>Q.3</b> <b>(B)</b>	<p>Given an image <math>F</math> of size <math>(4 \times 4)</math></p> <p>(a) If the gray level intensity changes are to be made as shown in figure given below. Derive the necessary expression for obtaining new pixel value using slope. [2 M]</p> <div style="display: flex; align-items: center; justify-content: center; margin: 20px 0;"> <div style="text-align: center;"> </div> <div style="margin-left: 20px;"> <math display="block">F = \begin{bmatrix} 2 &amp; 5 &amp; 3 &amp; 5 \\ 3 &amp; 6 &amp; 5 &amp; 3 \\ 3 &amp; 5 &amp; 2 &amp; 4 \\ 2 &amp; 5 &amp; 4 &amp; 5 \end{bmatrix}</math> </div> </div> <p>(b) Obtain the new image by applying the above transformation function. [4 M]</p> <p>(c) Plot Histogram for original image and new image. [2 M]</p> <p>(d) Compare the histogram of Input and Output Image. [2 M]</p>	10	CO2

<b>Q.4 (A)</b>	<p>Segment the following given image E such that the difference between maximum intensity value and minimum intensity value in the segmented region is less than 20 using Split and Merge technique. Specify Region Splitting and Merging Algorithm.</p> $R = \begin{bmatrix} 10 & 9 & 30 & 4 \\ 7 & 6 & 33 & 37 \\ 51 & 52 & 54 & 53 \\ 55 & 57 & 56 & 58 \end{bmatrix}$	10	CO2																									
<b>Q.4 (B)</b>	<p>For the binary image X and structuring element B, perform the following operations</p> <div><table border="1"><tr><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td></tr></table><p style="text-align: center;">X</p><table border="1"><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr></table><p style="text-align: center;">B</p></div> <p>a) Erosion b) Dilation c) Opening d) Closing e) State and prove duality property using X and B for erosion and dilation.</p>	0	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0	0	1	0	1	1	1	0	1	0	10	CO 2
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<b>Q.5 (A)</b>	<div></div> <p>The image consists of five vertical stripes. The gray levels of the stripes from left to right are 128, 64, 32, 16 and 8. The corresponding widths of the stripes are 35, 30, 20, 10 and 5 pixels respectively. If Huffman coding codes this stripe image, determine its efficiency.</p>	10	CO3																									
<b>Q.5 (B)</b>	<p>Prepare a question on object recognition methods or their applications for 10 marks. Write the suitable answer. Evaluate the answer out of 10 marks. Justify your evaluation. You will receive the marks based on following parameters:</p> <p>1) Quality of Question [2 M] 2) Quality of Answer [3 M] 3) Justification for marks given [5 M]</p>	10	CO 4																									