Sardar Patel Institute of Technology
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058, India
(Autonomous College Affiliated to University of Mumbai)

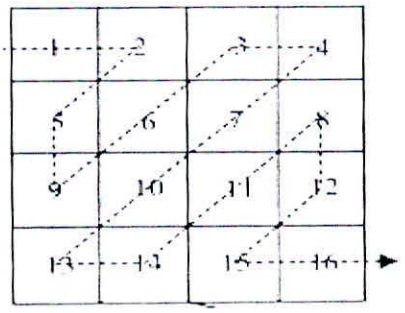
End Semester Examination
DECEMBER 2023

Max. Marks: 100 | Duration: 180 Min
Class: TE AIML-DS | Semester: V
Course Code: AI302 | Branch: CSE
Name of the Course: Fundamentals of Signal & Image Processing (FoSIP)

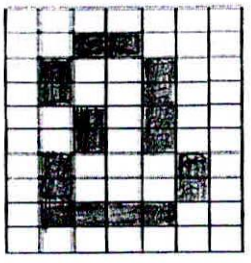
DS / AIML

Instructions:
(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. Marks	CO
Q.1 (A)	Attempt the following Short Answer Questions.		
	1. Let $x(t) = 8.6 \cos(400 \pi t) + 5.3 \sin(1100 \pi t) - 1.3 \sin(100 \pi t) + \sin(50 \pi t)$ is sampled with Fs = 1000 Hz. Each sample is converted to binary data using 8 bit ADC. Data thus obtained is transmitted serially. What will be the data rate per second ?	2	CO1
	2. Determine if the following given signal is periodic or not ? If periodic, find Period. $x[n] = 4 \cos(0.3 \pi n) + 7 \sin(0.25 \pi n)$	2	CO1
	3. What is the effect of Zero padding a signal in the frequency domain ? Justify .	2	CO1
	4. What is the significance of bit reversal technique? Where do you apply it ?	2	CO1
	5. **State whether True or False.** →Image Enhancement process does not change the information content of the image. Justify.	2	CO2
Q.1 (B)	**1. State whether True or False.** ⇒ The principal function of median filter is to force points with distinct intensity to be more like their neighbors. Justify your answer.	2	CO2

	2. **State whether True or False.** ⇒ First order derivative operators can detect any edge in the gray image. Justify your answer.	2	CO2
	3. Binary image F and Operator Mask W is given below. Perform Dilation of F by W. $F = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix} \quad W = \begin{bmatrix} 1 & 1 \end{bmatrix}$	2	CO4
	4. **State whether True or False.** ⇒ Run length coding always gives data compression. Justify your answer.	2	CO3
	5. Input image F is as given below: Arrange the pixels in the given input image by scanning the values in zig-zag order and then obtain a DPCM encoded image.. $F = \begin{bmatrix} 10 & 10 & 40 & 40 \\ 20 & 30 & 20 & 30 \\ 30 & 20 & 40 & 40 \\ 50 & 50 & 80 & 80 \end{bmatrix}$ (a) Input image **F**  (b) Zig-Zag order of scanning	2	CO3
Q.2 (A)	Let X[k] be the DFT of DT Signal x[n] such that X[k] = { 10, 20, 30, 40 } Find the DFT of the following sequences using X[k]. (1) $p[n] = (-1)^n x[n]$ (2) $q[n] = x[-n+2]$	10	CO1
Q.2 (B)	Given h[n]= { 1, 0, 2 } Find the response of a Digital FIR filter to the input x[n] = {3, 2, 1, 4, 3, -1, 1, 2, 5, -4, 3, 5 } using the Overlap & Save Method. Assume N = 8. OR Given h[n]= { 1, 0, 2 } The response of a Digital FIR filter to the input x[n] = {3, 2, 1, 4, 3, -1, 1, 2, 5, -4, 3, 5 } using block processing based on FFT/Inverse FFT. Consider the block size L=2 and calculate output of the filter for the first block of the signal i.e. for x[n] ={ 3, 2 }.	10	CO1

Q.3 (A)	1. Derive the Contrast Stretching Transformation function that compresses gray scale range [0, 30] into [0, 15] shifts range [30, 50] to [15, 35] and stretches the range [50, 63] into [35, 63]. 2. Apply the Contrast Stretching Transformation function derived in part-1 on the input image F as given below and obtain the new image. 3. If the Transformation function is repeatedly applied say infinite times on the input image , what will be the final digital image ? Justify your answer. Input Image is as given below: $F = \begin{bmatrix} 10 & 15 & 54 & 30 & 5 \\ 52 & 32 & 63 & 56 & 50 \\ 26 & 62 & 8 & 60 & 14 \\ 48 & 19 & 52 & 45 & 50 \\ 24 & 18 & 51 & 61 & 28 \end{bmatrix}$	10	CO2
Q.3 (B)	Given an 8 bit input image F, find the 8 bit quantized output image R by applying Laplacian High Boost filter mask. Assume virtual ROWs and COLUMNs with repeated border pixel values. Show the calculations for each output value. $F = \begin{bmatrix} 50 & 60 & 70 \\ 10 & 20 & 30 \\ 70 & 80 & 100 \end{bmatrix}$ OR Given a five bit image F : $F = \begin{bmatrix} 10 & 8 & 10 & 20 \\ 14 & 6 & 14 & 12 \\ 12 & 16 & 14 & 12 \end{bmatrix}$ 1. Determine the output image R using power law transformation $S = [r]^2$ 2. Obtain Digital Negative of the image obtained in part (1).	10	CO2
Q.4 (A)	For the image given below perform segmentation using Region Growing by Pixel Aggregation. Choose appropriate threshold and seed points. $F = \begin{bmatrix} 17 & 15 & 16 & 14 & 15 \\ 17 & 14 & 15 & 17 & 14 \\ 15 & 15 & 16 & 12 & 13 \\ 10 & 13 & 11 & 10 & 14 \\ 12 & 11 & 10 & 12 & 13 \end{bmatrix}$	10	CO2

Q4 (B)	Perform region filling operation on the following given binary image using Morphology. Use the appropriate region filling operator to obtain the result.  Shaded pixel indicates value = 1 and white coloured pixel indicates value = 0.	10	CO4
Q.5 (A)	Given, $$F = \begin{bmatrix} 12 & 12 & 13 \\ 13 & 10 & 13 \\ 57 & 54 & 11 \end{bmatrix}$$ (1) Find a 3-bit IGS coded image. (2) Calculate BPP & Compression factor. (3) Find decoded image and (4) Calculate MSE & PSNR OR Find Arithmetic codeword for the image given below $$F = \begin{bmatrix} 10 & 20 & 30 \\ 10 & 30 & 50 \end{bmatrix}$$ (1) Obtain the encoded image. (2) Calculate the percentage of compression. (3) Bits Per Pixel (BPP) of the compressed message. (4) Obtain decoded image.	10	CO3
Q5 (B)	It is required to design a real time system for digital audio password verification of the user using Correlation principle. Input Specification: Audio Signal (i.e. Speech Signal) Assume that Audio Signal of user is already captured. State the following : (a) Framework/block diagram of the DSP system. Justify the need of each process. (b) Algorithms/Flowchart and Explain the methodology to address the problem OR Design a real time Students Attendance System to measure the attendance during lecture. Problem Definition: Real-time Fingerprint Detection and Recognition. Input Specification: Real Time fingerprint image obtained using contactless camera.	10	CO4

Assume that the System is trained to recognize Fingerprint image,
A system should Match the fingerprint image with the image stored in the database, Recognize Student, and Mark Attendance with entry time.

Expected Output : Subject wise attendance of the students.

1. Draw Block Diagram/ Framework of the complete system that takes Input image, Process it and displays the appropriate output. Describe the functions of each block
2. Draw flowchart/write Algorithm of the different processes involved in the System.