UPES
End Semester Examination, May 2024

Program Name: M. Tech Robotics Engineering   Semester: II
Course Name: Digital Signal and Image Processing   Time: 3 Hrs
Course Code: ECEG-7039   Max. Marks: 100
Nos. of page(s): 2
 Instructions: Assume any data in the design, if required.

SECTION-A (5Q x 4M = 20 Marks)

S. No.		Marks	CO
Q.1	Differentiate Energy and Power signals with examples	**4**	**CO1**
Q.2	What is the concept of thresholding in image processing segmentation? Explain	**4**	**CO2**
Q.3	Detail how CMOS and CCD sensors work in image processing systems.	**4**	**CO1**
Q.4	What is the significance of the unit step, unit impulse, ramp, and exponential signal? Write the mathematical expression for discrete behavior and write the MATLAB code to analyze the behavior in -4 to +4 input range on the X-axis.	**4**	**CO2**
Q.5	Derive the mathematical equation of the single-layer perceptron ANN model and detail its functionality.	**4**	**CO2**

SECTION B (4Q x 10M = 40 Marks)
Attempt all the followings

Q.6	Prove that (3 x 3) means filter in the frequency domain and prove that it behaves like a low pass filter. Analyze the mathematical expressions for the same operation	**10**	**CO1**
Q.7	Show the details about the pictorial view of the bit plane slicing concept and write the MATLAB/Python code to support the functionality.	**10**	**CO2**
Q.8	Detail the significance of Sobel, Prewitt, and Schaar operators and their mathematical operations. ***OR*** Explain the functionality and mathematical equation for the Discrete Cosine/Sine Transform.	**10**	**CO3**
Q.9	**(a)** Perform the histogram equalization of the image and plot the histogram. $$\begin{bmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{bmatrix}$$ (**b**) Draw the block diagram of the automated pattern recognition system.	**5+5**	**CO4**

	SECTION-C (2Q x 20M = 40 Marks)		
Attempt any *two* of the following			
Q.10	**(a)** Explain the role of the median filter in image processing and derive the mathematical expression for its behavior as low pass filter. Compute the value of the marked pixels shown in (3 x 3) mask. $$\begin{bmatrix} 18 & 22 & 33 & 25 & 32 & 24 \\ 34 & 128 & 24 & 172 & 26 & 23 \\ 22 & 19 & 32 & 31 & 28 & 26 \end{bmatrix}$$ **(b)** Consider a case of the multicluster image processing system (8 x 8). Explain the optimal routing scheme with the mathematical calculations about maximum availability and links.	10+10	CO3
Q.11	**(a)** Detail the wavelet decomposition technique using the HAAR wavelet. Consider 256 x 256 DWT and decompose the image shown in Fig. to 2nd level. Fig.1 **(b)** Apply the region splitting and merging technique for the image given below. Draw the quadtree for (8 x 8), 2D image. Explain the detailed operation to support your answer. Fig.2	10+10	CO4
Q.12	**(a)** Draw the detailed diagram of the image processing system. **(b)** How image arithmetic helps for image processing. Write the MATLAB/ SCILAB script for at least 5 operations of image arithmetic.	10+10	CO2