NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Computer Science and Engineering
Course Code:	2CSDE78
Course Title:	Digital Image Processing and Analysis
Course Type:	Departmental Elective
Year of Introduction:	2021-22

Credit Scheme

L	T	Practical Component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. illustrate basic image acquisition mechanisms and image formats
2. identify various applications of digital image processing techniques
3. apply mathematical principles and signal processing concepts in digital image enhancement and restoration
4. develop various image representation stages for digital image processing applications

Syllabus: **Total Teaching hours: 45**

Unit	Syllabus	Teaching hours
Unit-I	**Introduction:** Origin and Applications of subject, Fundamental Steps in Digital Image Processing and Components of an Image Processing System, Image Sampling and Quantization, Basic Relationships between Pixels.	05
Unit-II	**Image Enhancement in the Spatial and Frequency Domain:** Background, Some Basic Gray Level Transformations, Histogram Processing Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Introduction to the Fourier Transform and the Frequency Domain, Smoothing and Sharpening Frequency Domain Filters	08
Unit-III	**Image Restoration:** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-invariant Degradations, Estimating the Degradation Function, inverse Filtering.	10
Unit-IV	**Color Image Processing:** Pseudo color Image Processing, Color Models	10

Image Compression: Fundamentals, Image Compression codecs (JPEG, PNG, GIF)

Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filling, Extraction of Connected Components, Convex-Hull, Thinning, Thickening, Skeletons, Pruning.

Unit-V	**Image Segmentation:** Edge Models Discontinuity based Image Segmentation, Similarity Based Image Segmentation	07

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors

Image denoising: Challenges and Techniques

Unit-VI	**Case Study:** Geo Spatial Image processing, Medical Image processing, thermal Image processing, sonar Image processing	05

Self-Study:	The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.
Suggested Readings/ References:	1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson education 2. Anil K. Jain, Fundamental of Digital Image Processing, Prentice Hall 3. Kenneth R. Castleman, Digital Image Processing, Paperback 4. Earl Gose, Johnsonbaug, Steve Jost, Pattern Recognition and Image Analysis PHI. 5. Rafael C. Gonzalez, Image Processing using MATLAB, PHI

Suggested List of Experiments:	Sr. No.	Practical Title	Hours
	1.	To write a computer program capable of reducing the number of intensity levels in an image from 256 to 2, in integer powers of 2. The desired number of intensity levels needs to be a variable input	02
	2.	To implement zooming and shrinking of an image using bilinear interpolation.	02
	3.	To write a program to load an image and then perform a simple spatial 3x3 average of image pixels. Repeat the process for a 5x5 neighbourhood and again for a 7x7 neighbourhood.	04

	4.	To perform intensity transformation on a given image
		   a. log transformation
		   b. gamma transformation
		   c. contrast stretching
			04

5. To experiment and analyse, how histogram equalization will help enhance the image provided during the lab session. Also use equalization on 5 different types of images and find out in which case it gives the weakest enhancement.   02

6. To write a program that performs image enhancement using spatial domain filters.   02

7. Write a programme: 04
   a. that performs image enhancement using frequency domain filters
   b. that accepts a noisy image and performs restoration.

8. To write a program that detects the following on an appropriate input image   04
   a. Line and edge detection using mask filters.
   b. Discontinuity detection

9. To segment the grey scale image and finding appropriate representation for the segmented shape   02

10. To write a program that provides an Interactive Segmentation for selection of object of interest and apply the user specified effect on the background. (Minimum offered Effects: Blur, Pencil Sketch, Water Colour, Vibrant, black and white, black and white red filter, pseudo color, canvas)   04

Suggested Case List: -NA-