NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	M.Tech. in Electronics & Instrumentation Engineering (Robotics and Artificial Intelligence)
Semester:	II
Course Code:	6CS851CC25
Course Title:	Digital Image Processing
Course Type:	Core
Year of introduction:	2025 - 26

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1.	illustrate basic image acquisition mechanisms and image formats	(BL2)
2.	identify various applications of digital image processing techniques	(BL3)
3.	apply mathematical principles and signal processing concepts in digital image enhancement and restoration	(BL3)
4.	develop various image representation stages for digital image processing applications.	(BL6)

Unit	Contents	Teaching Hours (Total 30)
Unit I	**Introduction** Origin and Applications of the 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.	07
Unit III	**Image Restoration** A Model of the Image Degradation/Restoration Process, Restoration in the Presence of Noise Only- Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Estimating the Degradation Function, inverse Filtering.	07
Unit IV	**Colour Image Processing** Pseudo colour Image Processing, Colour Models. Image Compression: Fundamentals, Image Compression codecs (JPEG, PNG, GIF) **Morphological Image Processing** Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filling.	07

Unit V **Image Segmentation** 04
Edge Models Discontinuity-based Image Segmentation, Similarity-Based
Image Segmentation
Representation and Description
Representation, Boundary Descriptors, Regional Descriptors

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.	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 area.	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 equalisation on five 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: a. that performs image enhancement using frequency domain filters b. that accepts a noisy image and performs restoration.	04

8. Write a program that detects the following on an appropriate input image

   a. Line and edge detection using mask filters.

   b. Discontinuity detection

   04

9. To segment the greyscale image and find an appropriate representation for the segmented shape

   02

10. To write a program that provides an Interactive Segmentation for selecting an object of interest and applying 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

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2025 - 26 and onwards