

## NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Electronics and Instrumentation Engineering
Semester:	V
Course Code:	
Course Title:	Image Processing and its Applications
Course Type:	Core
Year of Introduction:	2025-26

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### Course Learning Outcomes (CLOs):

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

1. illustrate the fundamentals of image processing techniques (BL2)
2. apply the algorithms used for image enhancement (BL3)
3. utilize the feature detection algorithms (BL3)
4. evaluate the theoretical concepts with the help of software simulation. (BL5)

Unit	Contents	Teaching hours (Total 45)
<b>Unit-I</b>	<b>Introduction</b> Introduction to Image Processing and its applications.	<b>01</b>
<b>Unit-II</b>	<b>Digital image fundamentals</b> Elements of visual perception, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, distance measurement, Arithmetic, logical and neighborhood operations on images.	<b>07</b>
<b>Unit-III</b>	<b>Image enhancement</b> Intensity transformations, histogram processing, spatial filtering, smoothing spatial filters, sharpening spatial filters, image smoothing using frequency-domain filters, image sharpening using frequency domain filters, selective filtering, Discrete Cosine Transform, Walsh Transform, Hadamard Transform.	<b>09</b>
<b>Unit-IV</b>	<b>Image restoration</b> Degradation models, estimating the degradation function, inverse filtering, wiener filtering.	<b>04</b>
<b>Unit-V</b>	<b>Morphological image processing</b> Dilation and erosion, opening and closing, hit-or-miss transformation, boundary extraction, extraction of connected component, thinning, thickening, convex hull, skeletons.	<b>06</b>
<b>Unit-VI</b>	<b>Image segmentation</b> Point, line and edge detection, thresholding, region-based segmentation.	<b>05</b>
<b>Unit-VII</b>	<b>Object representation, description and recognition</b> Chain codes, polygonal approximations, signatures, boundary segments, boundary descriptors, regional descriptors, patterns and pattern classes, recognition based on decision-theoretic methods, structural methods	<b>08</b>
<b>Unit-VIII</b>	<b>Applications &amp; case studies</b> Industrial applications of image processing, patterns classification, case studies.	<b>05</b>

**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. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Pearson Education India
2. A. Rosenfeld and A.C. Kak, Digital Picture Processing, Academic Press
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Prentice Hall of India Publications

**Suggested List of experiments:**

Laboratory work will be based on the above syllabus with a minimum 09 experiments/exercises to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

**(Only for Information)**

<b>Sr. No.</b>	<b>Name of Experiments/Exercises</b>	<b>Hours</b>
1.	Introduction to the simulation software	(02 Hrs)
2.	Implement arithmetic, logical and neighborhood operations on images	(02 Hrs)
3.	Implement connected component labelling algorithm	(02 Hrs)
4.	Implement contrast stretching and histogram equalization	(02 Hrs)
5.	Implement linear smoothing filter for image enhancement	(02 Hrs)
6.	Implement Median Fitter (nonlinear) for image enhancement	(02 Hrs)
7.	Apply image enhancement operations (Frequency domain)	(02 Hrs)
8.	Implement Discrete Cosine Transform, Walsh Transform and Hadamard Transform	(02 Hrs)
9.	Implement Morphological image processing operations	(02 Hrs)
10.	Implementation of image restoring techniques	(02 Hrs)
11.	Apply image segmentation operations	(02 Hrs)
12.	Obtain Chain codes for the object boundary in the image	(02 Hrs)
13.	Obtain projection profiles-based features for the object in the image	(02 Hrs)
14.	Design an application based on image processing	(02 Hrs)