

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering
Course Code:	3EC401ME24
Course Title:	Image Processing
Course Type:	Departmental Elective
Year of Introduction:	2024-25

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Course Learning Outcomes (CLOs):

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

1. comprehend image degradation models for image restoration and colour transforms. BL-2
BL-3
2. enhance image using spatial and frequency domain image processing.
3. employ object recognition and identification using morphological operations. BL-4
4. practise image segmentation and representation. BL-5

Unit No.	Contents	Teaching hours (Total 45)
I	Introduction: Structure of the human eye, light and the electromagnetic spectrum, image and quantisation, brightness adaption and discrimination, relationship between pixels, coordinate conventions and imaging geometry	04
II	Image Enhancement in Spatial Domain: Intensity transformations-negative, log, power log, contrast stretching, intensity level slicing, bit plane slicing, histogram processing-equalisation and specification, spatial correlation and convolution, spatial filtering - smoothing and sharpening filters, gradient and Laplacian	07
III	Filtering in the Frequency Domain: 2D DFT transforms and its properties, frequency domain filtering, image smoothing and sharpening using frequency domain filtering, selective filtering	05
IV	Image Restoration: Basic framework, image degradation model, noise characterisation, image denoising in spatial domain, periodic noise reduction by frequency domain, estimation of degradation functions, restoration techniques	06
V	Colour Image Processing: Colour Fundamentals, colour models- RGB model, CMY and CMYK model, HSI model, converting from HSI to RGB, pseudocolour image processing, intensity slicing, intensity to colour transformation, colour transformations, image segmentation based on colour	08
VI	Morphological Image Processing: Basics of structuring element, erosion, dilation, opening, closing, hit-or-miss transform, basic morphological algorithms	05
VII	Image Segmentation: Line and edge detectors, thresholding, pixel and region-based segmentation – region growing, region splitting and merging, segmentation using watersheds	05



VIII Representation and description: Representation-chain codes, polygonal approximation, MPP, signatures, boundary segments, skeleton, boundary descriptors, regional descriptors, case studies and applications

05

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

**Suggest List of Tutorials (not restricted to the following):
(Only for information)**

Sr. No.	Title of the tutorial	Hours
1.	Basic image handling operations and visualisation for different image types	01
2.	Implementation of various arithmetic operations on images, histogram processing and perform image enhancement through point processing operations	01
3.	Implementation of image smoothing and sharpening using spatial domain filtering for image enhancement and observe the effect on the output by varying filter parameters	02
4.	Implementation of Discrete Fourier Transform on images and design, implement and observe the effects LPF, HPF, BPF and BSF filters for image smoothing, sharpening and noise removal	02
5.	Denoising of images corrupted by various noise and denoise them.	01
6.	Exploration of the properties of different blur kernels and perform image restoration by application of image deblurring techniques	01
7.	Generation of masks for detection of particular edges in an image and realise edge detection algorithms	01
8.	Implementation of morphological operations such as opening, closing, erosion and dilation and observe the effects of structuring element	01
9.	Performance of image segmentation using thresholding, Otsu's method and clustering for object detection applications	01
10.	Performance of conversion between various image colour models, process colour images and pseudocolour image processing	01
11.	Performance of image segmentation based on colour	01
12.	Application of image processing for a given problem statement	02

Suggested Readings:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education
2. A.K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall
3. Sridhar, Digital Image Processing, Oxford University Press
4. Vipula Singh, Digital Image Processing with MATLAB and LabView, Elsevier
5. S.Jayaraman, S. Esakkirajan, T. Veerakumar, Digital Image Processing, Tata McGraw-Hill