

Subject Title: Digital Image Processing					
Course Code: PC3101L	Year and Semester: III Year I Semester	L	T	P	C
Prerequisites: Nil		3	1	-	3

### Course Objectives:

1. Familiarize with basic concepts of digital image processing.
2. Learn various image processing techniques like image enhancement both in spatial and frequency domain
3. Familiarize with basic restoration techniques
4. Understand segmentation and morphological techniques applicable to various tasks
5. Understand the need for compression and familiarize few compression methods

Syllabus		
Unit No	Contents	Mapped CO
I	<b>FUNDAMENTALS OF IMAGE PROCESSING</b> Introduction, Fundamental steps in image processing, Image sampling, Quantization, Resolution, Elements of image processing system, Applications of Digital image processing. Color fundamentals, Color image formats and conversion.	CO1
II	<b>IMAGE ENHANCEMENT</b> <b>Spatial domain methods:</b> Point & Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. <b>Frequency domain methods:</b> Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.	CO2
III	<b>IMAGE RESTORATION AND RECONSTRUCTION</b> A model of the image degradation and 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, Minimum mean square error (Wiener) filtering, constrained least squares filtering.	CO3
IV	<b>IMAGE SEGMENTATION</b> Fundamentals, point, line, edge detection, thresholding, and region –based segmentation. <b>MORPHOLOGICAL IMAGE PROCESSING</b> Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning.	CO4
V	<b>IMAGE COMPRESSION</b> Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding.	CO5

### **Content beyond Syllabus**

Basic concepts of Pattern Recognition and examples of Pattern Recognition (Finger Print Recognition, etc.) Systems, Linear Decision Functions with examples illustrating various cases, concept of pattern space and weight space.

### **Course Outcomes:**

<b>Course Outcomes</b>	
Upon successful completion of the course, the student will be able to	
<b>CO1</b>	<b>Perform</b> image manipulations and color format conversions. { <b>Understanding level, KL2</b> }
<b>CO2</b>	<b>Apply</b> various spatial and frequency domain techniques for the smoothing and sharpening of images. { <b>Applying level, KL3</b> }
<b>CO3</b>	<b>Describe</b> various image restoration techniques. { <b>Understanding level, KL2</b> }
<b>CO4</b>	<b>Apply</b> various segmentation and morphological operators on images. { <b>Applying level, KL3</b> }
<b>CO5</b>	<b>Analyze</b> the performance of different image compression techniques. { <b>Analyzing level, KL4</b> }

### **Learning Resources**

#### **Text books:**

1. Digital Image Processing – Gonzalez and Woods, 2nd Ed., Pearson.
2. S. Jayaraman, S. Esakkirajan and T. VeeraKumar, “Digital Image processing, Tata McGraw Hill publishers, 2009

#### **Reference books:**

1. Joseph Howse, Joe Minichino, “Learning OpenCV 4 Computer Vision with Python 3\_ Get to grips with tools, techniques, and algorithms for computer vision and machine learning”, Packt Publishing, 2020.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
3. J. T. Tou, R. C. Gonzalez, “Pattern Recognition Principles”, Addison-Wesley, 1974.
4. B. Chanda, D. Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2009.

#### **E-Resources & other digital material:**

NPTEL Lecture material

1. Lecture Series on Digital Image Processing by Prof. P. K. Biswas, Department of Electrical & Electronic Communication Engineering, IIT Kharagpur.  
<https://www.youtube.com/playlist?list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8>
2. OpenCV: <https://opencv.org/>
3. SCikit-Image: <https://scikit-image.org/>
4. SciPy: <https://scipy.org/>

5. PIL:
  - a. <https://pillow.readthedocs.io/en/stable/>
  - b. <https://pillow.readthedocs.io/en/stable/handbook/tutorial.html>
  - c. <https://realpython.com/image-processing-with-the-python-pillow-library/#image-segmentation-and-superimposition-an-example>
6. Mahotas: <https://mahotas.readthedocs.io/en/latest/>
7. SimpleITK:
  - a. <http://insightsoftwareconsortium.github.io/SimpleITK-Notebooks/>
  - b. <https://notebooks.gesis.org/binder/jupyter/user/insightsoftware-leitk-notebooks-qj4qqkdc/lab/tree/Python>
8. Pgmagic: <http://www.graphicsmagick.org/>