

Subject Code: 1ET2030104	Subject Title: DIGITAL IMAGE PROCESSING (Elective – I)
Pre-requisite	Computer Graphics

Course Objective:

Main objective of this course is to make the students aware about producing mathematical model of images. It also helps the students to understand the various operations that can be performed on images. The course shall help gaining experience in applying image processing algorithms to real life problems like image enhancement & restoration of noisy images.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	2	4	60	40	30	20	150

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
01	Introduction to Digital Image Processing: The origin of Digital Image Processing, Examples of fields that use Digital Image Processing, Fundamental Steps in Digital Image Processing and Components of an Image Processing System, Elements of Visual Perception Light and Electromagnetic Spectrum, Image Sampling and Quantization, Basic Relationships Between Pixels and Linear and Nonlinear Operations, Image Sensing and Acquisition	5	21	
02	Image Enhancement: 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	7	29	
03	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, Position invariant Degradations, Estimating the Degradation Function, Inverse Filtering & Minimum Mean Square, Error (Wiener) Filtering, Constrained Least Squares Filtering	4	17	
04	Morphological Image processing: Preliminaries, Dilation and Erosion, Opening and Closing - Hit-or-Miss Transformation, Basic morphological algorithms for boundary extraction, Region filling, Extraction of connected components, Thinning and thickening	4	17	
05	Image Segmentation: Edge Models Discontinuity based Image Segmentation, Similarity Based Image Segmentation	2	08	
06	Representation and Description: Representation, Boundary Descriptors, Regional Descriptors	2	08	

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same.

Recommended sites for journal papers are (1) dl.acm.org (2) springer.com (3) sciencedirect.com (4) elsevier.com (5) ieeexplore.ieee.org (6) scholar.google.co.in (7) scopus.com or others of similar repute.

Course Outcomes:

After successful completion of this course, student will be able to:

- Understand basic of image processing, acquisition, formats, color models, representations.
- Understand basics of image compression standards. Understand various applications of digital image processing.
- Apply mathematical principles and signal processing concepts in digital image enhancement and restoration.
- Design and develop various image representation stages for digital image processing applications.

List of 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.

E-Resources / Web Links:

1. www.nptel.ac.in/courses/106105032/
2. www.cs.nmt.edu/~ip/lectures.html
3. www.virtual-labs.ac.in/computer-science-and-engineering-labs.html

List of Experiments:

(Note: The experiment list provided beneath is for reference only. The course teacher may change/formulate it as per his/her methodology and requirement.)

- 01 To study about MATLAB.
- 02 Implement the spatial image enhancement functions on a bitmap image –Mirroring (Inversion)
- 03 Write a program to zoom and shrink an image using bilinear interpolation.
- 04 Write a computer program capable of reducing the number of intensity levels in an image from 256 to 2, in integer powers of 2.
- 05 Use fast Fourier transform to enhance the noisy images. Conclude which kind of image enhancement will be effective on different types of noise. (Note: Use imnoise() to introduce noise in a given image)
- 06 Experiment and analyze 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.
- 07 Using any programming language, you feel comfortable with, load an image and then perform a simple spatial 3x3 average of image pixels. In other words, replace the value of every pixel by the average of the values in its 3x3 neighborhood. If the pixel is located at (0,0), this means averaging the values of the pixels at the positions (-1,1), (0,1), (1,1), (-1,0), (0,0), (1,0), (-1,-1), (0,-1), and (1,-1).
- 08 Implement (a) Low Pass Filter (b) High Pass Filter
- 09 Implement Smoothing and Sharpening of an eight bit color image
- 10 Convert the given image to resemble a pencil sketch. Document which process have you used and how it works for you to achieve your final output.
- 11 Segment an object of interest from the grey scale image and change its background.
- 12 Segment an image and find appropriate shape representation for recognizing basic geometric figures.
- 13 Implement (a) Edge Detection (b) Line Detection