Image Processing

Course Title: Image Processing
Course No: CSC321
Nature of the Course: Theory + Lab
Semester: V

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course covers the investigation, creation and manipulation of digital images by computer. The course consists of theoretical material introducing the mathematics of images and imaging. Topics include representation of two-dimensional data, time and frequency domain representations, filtering and enhancement, the Fourier transform, convolution, interpolation. The student will become familiar with Image Enhancement, Image Restoration, Image Compression, Morphological Image Processing, Image Segmentation, Representation and Description, and Object Recognition.

Course Objectives: The objective of this course is to make students able to:

- develop a theoretical foundation of Digital Image Processing concepts.
- provide mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
- gain experience and practical techniques to write programs for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.

Course Contents:

Unit 1: Introduction (5 Hrs.)
Digital Image, A Simple Image Model,Fundamental steps in Image Processing, Elements of Digital Image Processing systems, Element of visual perception, Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, DistanceMeasures between pixels

Unit 2: Image Enhancement and Filter in Spatial Domain (8 Hrs.)
Point operations, contrast stretching, clipping and thresholding, digital negative, intensity level slicing, bit plane slicing, Histogram Equalization, Spatial operations: Averaging, median, filtering spatial low pass and high pass, high boost filter, high frequency emphasis filter, Laplacian filter, magnification by replication and interpolation.

Unit 3: Image Enhancement in the Frequency Domain (8 Hrs.)
Introduction to Fourier Transform and the frequency Domain, Computing and Visualizing the 2D DFT, Fast Fourier Transform, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Other Image Transforms (Hadamard transform, Haartransform and Discrete Cosine transform)

Unit 4: Image Restoration and Compression (8 Hrs.)
Image Restoration: Models for Image degradation and restoration process, Noise Models, Estimation of Noise Parameters, Restoration Filters, Bandrejected Filters, Bandpass Filters.
Image Compression: Image compression models, Pixel coding: run length, bit plane, Predictive and inter-frame coding

Unit 5: Introduction to Morphological Image Processing (2 Hrs.)
Logic Operations involving binary images, Dilation and Erosion, Opening and Closing.

Unit 6: Image Segmentation (8 Hrs.)
Image Segmentation: Point Detection, Line Detection, Edge Detection, Gradient Operator, Edge Linking and Boundary Detection, Hough Transform, Thresholding, Region-oriented Segmentation.

Unit 7: Representations, Description and Recognition (6 Hrs.)
Introduction to some descriptors (Chain codes, Signatures, Shape Numbers, Fourier Descriptors), Patterns and pattern classes, Decision-Theoretic Methods, Overview of Neural Networks in Image Processing, Overview of pattern recognition.

Laboratory Work: Students are required to develop programs in related topics using MatLab or suitable programming language.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Edition, Latest Edition.

Reference Books:

1. I. Pitas, "Digital Image Processing Algorithms", Prentice Hall, Latest Edition.
2. A. K. Jain, “Fundamental of Digital Image processing”, Prentice Hall of India Pvt. Ltd., Latest Edition.
3. K. Castlemann, “Digital image processing”, Prentice Hall of India Pvt. Ltd., Latest Edition.
4. P. Monique and M. Dekker, “Fundamentals of Pattern recognition”, Latest Edition.