VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

NAMBUR-522508 ANDHRA PRADESH, INDIA

Course Code:	**Subject Title: Digital Image Processing**
Year and Semester: III Year I semester	

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

UNIT – I

Fundamentals of Image Processing: 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.

UNIT – II

Image Enhancement:

Spatial domain methods: Point & Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT – III

Image Restoration and Reconstruction

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.

UNIT – IV

Image Segmentation: Fundamentals, point, line, edge detection, thresholding, and region –based segmentation.

Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning.

UNIT – V

Image Compression: 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.

Content beyond syllabus:

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

Text Books:

1. Digital Image Processing – Gonzaleze and Woods, 2nd Ed., Pearson.
2. S. Jayaraman, S. Esakkirajan and T. VeeraKumar, “Digital Image processing,

Tata McGraw Hill publishers, 2009

Reference Books:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. J. T. Tou, R. C. Gonzalez, "Pattern Recognition Principles", Addison-Wesely, 1974.
3. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Micro Syllabus of Design and Analysis of Algorithms

UNIT I

Fundamentals of Image Processing: 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.

Unit	Module	Micro Content
UNIT I	Introduction	Image formation model
	Sampling, Quantization, and Resolution	Effect of spatial and gray level resolution on image quality
	Image file formats	BMP, PNG, PGM, TIFF, JPEG file formats
	Elements of image processing systems	Various hardware and software elements required in realizing an image processing application.
	Applications of Image Processing	Examples of fields that use digital image processing
	Introduction to color spaces	How color is represented in digital computers, primary and secondary colors
	Color image formats and conversion	Conversion from RGB to HSV and HSV to RGB, RGB to CMY and CMY to RGB.

UNIT – II

Image Enhancement:
Spatial domain methods: Point & Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.
Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Unit	Module	Micro Content
UNIT II	Point Processing	Image negative, log, power law, contrast stretching, slicing
	Histogram Processing	Histogram Equalization
		Histogram Matching or specification
		Local enhancement
	Spatial filtering	Fundamentals of mask processing
	Smooting	Linear, and ordered-statistic filters
	Sharpening	Enhancement using first and second

		order derivatives, un-sharp masking and high boost filtering
	Basics of filtering in the frequency domain	Appearance of magnitude spectrum of an image with respect to its spatial domain visual information, why centering of the transforms is required?
	Smoothing	Butterworth, Gaussian LPF
	Sharpening and selective filtering	Butterworth, Gaussian HPF
		Un-sharp masking, High-boost filtering, and High-frequency emphasis, and selective filtering

UNIT– III

Image Restoration and Reconstruction: 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.

Unit	Module	Micro Content
UNIT III	Introduction	Degradation and restoration model
	Restoration in presence of noise only	Estimation of noise type and their parameters, their removal using spatial filters, periodic noise removal using frequency domain filtering.
	Estimation of degradation	Different methods of estimating the degradation present in the image
	Restoration of degraded image	Inverse, Wiener, and constrained least squares filtering

UNIT – IV

Image Segmentation: Fundamentals, point, line, edge detection, thresholding, and region –based segmentation.

Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning.

Unit	Module	Micro Content
UNIT IV	Detection of discontinuities	Fundamentals of image segmentation, and detection of isolated points, and lines
	Edge detection	Concept of edge, edge detection using first (Sobel and Prewitt) operators, effect of noise in the detection of edges
		Second order derivative (Laplacian and LoG) operators, effect of noise in the detection of edges
	Thresholding	Foundation and role of illumination
		Global and adaptive thresholding
	Region based segmentation	Basic fundamentals, region growing
		Region splitting and merging
	Preliminaries	Set theory and logic operations

	Erosion and Dilation	With examples
	Opening and Closing	Explain how the shape of a binary object changes
	Hit-or-miss Transform	Locating object of particular shape
	Basic morphological algorithms	Boundary extraction
		Thinning

UNIT V

Image Compression: 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.

Unit	Module	Micro Content
UNIT V	Introduction	Need for image compression
	Redundancy	Types of redundancy in images
	Compression schemes	Lossless and Lossy compression
	Information theory	Measure of information, entropy
	Source coding	Shannon-Fano coding
		Huffman coding
		Arithmetic coding
	Spatial redundancy	Run length coding, LZW coding
	Predictive coding	Linear Predictive coding

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