

**VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY NAMBUR-522508 ANDHRA PRADESH, INDIA**

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| 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**

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| **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** | |
|  | 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 | |
| **UNIT IV** | 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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