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| MONO | **DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**  **NATIONAL INSTITUTE OF TECHNOLOGY PATNA**  Ashok Raj Path, PATNA 800 005 (Bihar), India |
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**CSX441 Digital Image Processing**

**L-T-P-Cr: 3-0-0-3**

**Pre-requisites:** Linear algebra, Matrices, Matrix Operations, Determinants, Systems of Linear Equations, Eigen values, Eigenvectors, Statistics and probability, Programming experience, preferably in matlab, and/or C/C++/C#/Python/Java

**Objectives/Overview:**

* To introduce the student to various image processing techniques and image fundamentals.
* To describes the main characteristics of digital images, how they are represented. Mathematical transforms such as such as Fourier, Cosine transforms, Singular value decomposition, 2D Wavelet transform, image enhancement techniques.
* Image restoration and denoising, segmentation, lossy and lossless data compression algorithms, binary and color image processing.
* To exposed students to dealing with image data through programming assignments using matlab, and/or C/C++/C#/Python/Java.

**Course Outcomes:**

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| **S.NO** | **Course outcomes ( Digital Image Processing )** | **Level of Attainment** |
| CO-1 | To understand the digital image fundamentals | Familiarity |
| CO-2 | To understand the concept of image transformation algorithms/techniques | Assessment |
| CO-3 | To understand the basic concepts compression algorithms/techniques | Assessment |
| CO-4 | To understand the basic concepts of image enhancement and segmentation algorithms/techniques | Assessment |
| CO-5 | To understand the basic concepts of  **image restoration and denoising** algorithms/techniques | Technical skills |
| CO-6 | To understand the basic concepts of binary and color image processing | Assessment |

**UNIT I: Introduction to Digital Image Processing and Transformation Lectures: 11**

Introduction to images and its processing, Components of image processing systems, image representations, Image file formats, recent applications of digital image processing, image sampling and quantization, Image Analysis, Intensity transformations, contrast stretching, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian. Need for transform, Fourier, Cosine transforms, Haar, KL Transform, Singular value decomposition, 2D Wavelet transform, Different properties of image transform techniques.

**UNIT II: Image Compression Basics and Enhancement Techniques Lectures: 13**

Concept of image compression, lossless techniques (Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques) and lossy compression techniques (Transform Coding & K-L Transforms, Discrete Cosine Transforms, and BTC), Multi-Resolution Analysis, and Still Image Compression Standards (JBIG and JPEG).

**Enhancement in spatial and transform domain,** histogram equalizationDirectional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homo-morphic filtering, Color image enhancement.

**UNIT III: Image Restoration, Denoising and Image Segmentation Lectures: 10**

Image degradation, Type of image blur, Classification of image restoration techniques, ,image restoration model, Linear and non linear restoration techniques, Image denoising, Median filtering.

**Classification of image segmentation techniques,** Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

**UNIT IV: Binary and Color image processing Lectures: 05**

Binarization, Basic Set theory, Binary morphological operations and its properties, Color Image Representation in MATLAB, Converting Between Color Spaces, The Basics of Color Image Processing, Color Transformations, Spatial Filtering of Color Images, Working Directly in RGB Vector Space.

**UNIT V: Applications Lectures: 03**

Applications of digital image processing**:** Case studies

**Text/Reference Books**

1. Digital Image Processing, R.C. Gonzalez and R.E. Woods, 2nd edition, Pearson Prentice Hall, 2008
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall, 1989.
3. Digital Image processing, S Jayaraman, TMH, 2012
4. William K. Pratt, *Digital Image Processing*, 3rd Edition, John Wiley, 2001.

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

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| **Course outcomes (**CSX441  **Digital Image Processing)** | **Level of Attainment** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **Weightage** |
| To understand the digital image fundamentals | Familiarity | H | H | H | M | H | H | M | M | M | M | M | H | 60% |
| To understand the concept of image transformation algorithms/techniques | Assessment | H | H | H | M | M | M | M | M | M | M | M | H | 77% |
| To understand the basic concepts compression algorithms/techniques | Assessment | H | H | H | M | H | M | M | M | M | M | M | H | 85% |
| To understand the basic concepts of image enhancement and segmentation algorithms/techniques | Assessment | H | H | H | M | H | M | M | M | M | M | M | H | 85% |
| To understand the basic concepts of  **image restoration and denoising** algorithms/techniques | Technical skills | H | H | H | M | H | M | M | M | M | M | M | H | 85% |
| To understand the basic concepts of binary and color image processing | Assessment | H | H | H | M | H | M | M | M | M | M | M | H | 85% |
| Weightage |  | 100% | 100% | 100% | 70% | 80% | 90% | 60% | 80% | 100% | 70% | 80% | 100% |  |
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| **Graduate Attributes/Program Outcomes** | |
| **PO-1** | **Engineering knowledge** |
| **PO-2** | **Problem analysis:** |
| **PO-3** | **Design/development of solutions:** |
| **PO-4** | **Conduct investigations of complex problems:** |
| **PO-5** | **Modern tool usage:** |
| **PO-6** | **The engineer and society:** |
| **PO-7** | **Environment and sustainability:** |
| **PO-8** | **Ethics:** |
| **PO-9** | **Individual and team work:** |
| **PO-10** | **Communication:** |
| **PO-11** | **Project management and finance:** |
| **PO-12** | **Life-long learning:** |