M.Sc. Computer Science Syllabus First Year (2018-23)

Digital Image Processing

Semester II	Subject Code: MS21801	Lectures: 60

Objectives:

The syllabus aims in equipping students with,
- ➢ the awareness of Digital Image Processing,
- ➢ hands on processing tool like MATLAB

Unit 1: Fundamentals of Digital Image Processing	9

Ch 1: Introduction	4

- The origins of Digital Image Processing
- Examples of Fields that use Digital Image Processing
    - ➢ Gamma-Ray Imaging
    - ➢ X-Ray Imaging
    - ➢ Imaging in the Ultraviolet Band
    - ➢ Imaging in the Visible and Infrared Bands
    - ➢ Imaging in the Microwave Band
    - ➢ Imaging in the Radio Band
- Fundamental steps in Digital Image Processing
- Components of an Image Processing System
- Elements of Visual Perception
- Light and the Electromagnetic Spectrum
- Image sensing and Acquisition
- Image Sampling and Quantization
- Some Basic Relationships between Pixels

BOS Members:

Dr. Reena Bharathi (Subject Expert)

Dr.Manisha Bharambe (Subject Expert)

Dr. Jyoti Yadav (Subject Expert)

Mr Vishal Salke (Industry Expert)

Ms Amruta Nambiar(Alumni)

Prof. Ashwini Kulkarni (Chairman and Internal faculty)

Prof. Smita Borkar (Internal Faculty)

Ch 2: Digital Image Fundamentals	5

- An Introduction to the Mathematical Tools Used in Digital Image Processing
  - ➤ Array versus Matrix Operations
  - ➤ Linear versus Nonlinear Operations
  - ➤ Arithmetic Operations
  - ➤ Set and Logical Operations

Unit 2: Intensity Transformation and Filtering	17
Ch 3: Intensity Transformation and Spatial Filtering	11

- Background
- Some Basic Intensity Transformation Functions
- Histogram Processing
  - ➤ Histogram Equalization
  - ➤ Histogram Matching (Specification)
  - ➤ Local Histogram Processing
- Fundamentals of Spatial Filtering
- Smoothing Spatial Filters
- Sharpening Spatial Filters
- Combining Spatial Enhancement Methods

Ch 4: Filtering in Frequency Domain   6
  - ➤ Background
  - ➤ Preliminary Concepts
  - ➤ Sampling and the Fourier Transform of Sampled Functions
  - ➤ The Discrete Fourier Transform (DFT) of One variable
  - ➤ Extension to Functions of Two Variables
  - ➤ Some Properties of the 2-D Discrete Fourier Transform
  - ➤ The Basics of Filtering in the Frequency Domain
  - ➤ Image Smoothing Using Frequency Domain Filters
  - ➤ Image Sharpening Using Frequency Domain Filters
  - ➤ Selective Filtering

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Unit 3: Image Restoration and Reconstruction	5

Ch 5: Image Restoration and Reconstruction
- 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
  - ➢ Bandreject Filters
  - ➢ Bandpass Filters
  - ➢ Notch Filters
- Estimating the Degradation Function
- Inverse Filtering
- Minimum Mean Square Error(Wiener) Filtering
- Geometric Mean Filter

Unit 4: Morphological Image Processing	5

Ch 6: Morphological Image Processing
- Preliminaries
- Erosion and Dilation
- Opening and Closing
- The Hit-or-Miss Transformation
- Some Basic Morphological Algorithms
  - ➢ Boundary Extraction
  - ➢ Hole Filling
  - ➢ Extraction of Connected Components
  - ➢ Convex Hull
  - ➢ Thinning
  - ➢ Thickening

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Unit 5: Image Segmentation with Representation and Description	12

Ch 7: Image Segmentation   7
- Fundamentals
- Point, Line, and Edge Detection
  - ➢ Background
  - ➢ Detection of Isolated Points
  - ➢ Line Detection
  - ➢ Edge Models
  - ➢ Basic Edge Detection
  - ➢ Edge Linking and Boundary Detection
- Thresholding
  - ➢ Foundation
  - ➢ Basic Global Thresholding
  - ➢ Optimum Global Thresholding Using Otsu's Method
  - ➢ Using Image Smoothing to Improve Global Thresholding
  - ➢ Using Edges to Improve Global Thresholding
- Region-Based Segmentation

Ch 8: Representation and Description   5
- Image Representation and Description
- Representation
  - ➢ Boundary (Border) Following
  - ➢ Chain Codes
  - ➢ Polygonal Approximations Using Minimum-Perimeter Polygons
  - ➢ Other Polygonal Approximation Approaches
  - ➢ Signatures

    *Contact hours – 12 hours

Reference Books:

1. Gonzalez, R. C. and Woods, R. E. [2002/2008], *Digital Image Processing*, 3rd ed., Prentice Hall
2. Sonka, M., Hlavac, V., Boyle, R. [1999]. *Image Processing, Analysis and Machine Vision (2nd edition)*,PWS Publishing, or (3rd edition) Thompson Engineering, 2007

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