# Course Title: **Image Processing and Pattern Recognition**

Course Code: **COMP**

Administration: **Eight Semester**

Duration: **One Semester**

Class Load: **8 Hrs. per Week (Theory: 4 Hrs., Tutorial: 2 Hrs., Practical: 2 Hrs.,)**

**Evaluation:**

|  |  |  |
| --- | --- | --- |
| Theory | Practical | Total |
| Sessional | 30 | 20 | 50 |
| Final | 50 | - | 50 |
| Total | 80 | 20 | 100 |

**Course Objectives:**

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

**Course Contents:**

1. **Introduction to Digital Image Processing (4 Hrs)** 
   1. The origins of Digital Image Processing
   2. Examples of Fields that Use Digital Image Processing
   3. Fundamentals Steps in Image Processing
   4. Elements of Digital Image Processing Systems
   5. Image Sampling and Quantization
   6. Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels,
   7. Elements of Visual Perception
2. **Image Enhancement in Spatial Domain (7 Hrs)** 
   1. Some basic Gray Level Transformations
      1. Point operations
      2. Contrast stretching,
      3. Thresholding,
      4. Digital negative,
      5. Intensity level slicing
      6. Bit Plane Slicing
   2. Histogram Processing and Equalization
   3. Enhancement Using Arithmetic and Logic operations
   4. Basics of Spatial Filters
   5. Smoothening and Sharpening Spatial Filters
      1. Averaging
      2. Median filtering
      3. Spatial Low Pass
      4. High pass filtering
      5. Magnification by replication and interpolation
   6. Combining Spatial Enhancement Methods

**3. Image Enhancement in the Frequency Domain (6 Hrs)**

* 1. Introduction to Fourier Transform and the frequency Domain
  2. Computing and Visualizing the 2D DFT
  3. Smoothing Frequency Domain Filters
  4. Sharpening Frequency Domain Filters,
  5. Other Image Transforms
     1. Hadamard transform
     2. Haar transform
     3. Discrete Cosine transform
  6. Fast Fourier Transform

**4. Image Restoration (4 Hrs)**

* 1. A model of The Image Degradation / Restoration Process,
  2. Noise Models Restoration in the presence of Noise Only Spatial Filtering
  3. Periodic Noise Reduction by Frequency Domain Filtering

**5. Image Compression (6 Hrs)**

* 1. Coding Redundancy
     1. Huffman coding
  2. Interpixel Redundancy
     1. Run length Coding
  3. Psychovisual Redundancy
  4. Image Compression models
  5. Lossless and Lossy Compressions
     1. Predictive coding

**6. Introduction to Morphological Image Processing (4 hrs)**

* 1. Logic Operations involving binary images
  2. Dilation and Erosion
  3. Opening and Closing

**7. Image Segmentation (7 hrs)**

* 1. Detection of Discontinuities
  2. Edge linking and boundary detection
  3. Thresholding
  4. Region Based Segmentation

**8. Representations and Description (3 hrs)**

* 1. Introduction to some descriptors
     1. Chain codes
     2. Signatures
     3. Shape Numbers,
     4. Fourier Descriptors

1. **Object Recognition (3 hrs)**
   1. Patterns and pattern classes
   2. Decision-Theoretic Methods
   3. Overview of Neural Networks in Image Processing
2. **Pattern Recognition (1 hr)**
   1. Overview of pattern recognition

**Laboratory:**

* Student should write programs related to different image enhancement techniques, image restoration techniques, morphological operations and image segmentation techniques.

**Text Books:**

* Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Prentice Hall of India Pvt. Ltd., 2010.

**References:**

1. I. Pitas, "Digital Image Processing Algorithms", Prentice Hall, 2009.
2. A. K. Jain, “Fundamental of Digital Image processing”, Prentice Hall of India Pvt. Ltd., 2011.
3. K. Castlemann, “Digital image processing”, Prentice Hall of India Pvt. Ltd., 2010.
4. R. C. Gonzalez and P. Wintz, “Digital Image Processing”, Addison-Wesley Publishing, 2009.
5. P. Monique and M. Dekker, “Fundamentals of Pattern recognition”, 2007.

M. James, “Pattern recognition”, BSP professional books, 2008.