# PS 604.2 [E2]: IMAGE PROCESSING AND PATTERN RECOGNITION

## Unit – I

**Digital Image Processing**:

* Origins of Digital Image Processing,
* Examples of fields that use DIP,
* Fundamental Steps in Digital Image Processing,
* Components of an Image Processing System.

**Digital Image Fundamentals**:

* Elements of Visual Perception,
* A Simple Image Formation Model,
* Sampling and Quantization,
* Representing Digital Images,
* Spatial and Gray-level Resolution,
* Zooming and shrinking,
* Basic Relationships Between Pixels,
* Linear and Nonlinear Operations.

## Unit – II

**Image Enhancement in the Spatial Domain**:

* Gray Level Transformations,
* Histogram Processing,
* Enhancement Using Arithmetic/Logic Operations,
* Basics of Spatial Filtering,
* Combining Spatial Enhancement Methods.

**Image Enhancement in the Frequency Domain**:

* Introduction to the Fourier Transform and the Frequency Domain,
* Frequency-Domain Filters,
* Homomorphic Filtering.

**Image Restoration**:

* Image degradation/Restoration process,
* Noise Models, Restoration in,
* Periodic Noise Reduction,
* Degradations,
* Degradation Function,
* Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering,
* Least Square Filtering,
* Geometric Mean Filter

## Unit – III

**Image Segmentation:**

* + Detection of Discontinuities,
  + Edge Linking and Boundary Detection,
  + Thresholding,
  + Region-Based Segmentation.

**Image Feature Extraction:**

* Image Features and Extraction–Image Features–
  + Types of Features–Feature Extraction–SIFT,
* SURF and Texture–Feature Reduction Algorithms

**Image Representation:**

* + Representation,
  + Boundary Descriptors,
  + Regional Descriptors,

## (10hrs)

**Unit – IV**

**Introduction to Pattern Recognition** :

* Elements of Image Analysis,
* Introduction to pattern classification Feature selection and extraction,
* Supervised and Unsupervised Parameter estimation Basic concepts- Structure of a typical pattern recognition system Feature vectors ,
* Feature spaces,
* Pattern classification by distance functions –
  + Minimum distance classification - Cluster algorithms

**Unit - V**

**Pattern Classification:**

* Pattern classification using Statistical classifiers and Bayes’ classifier Classification performance measures –
  + Risk and error probabilities.
* Fuzzy classification –
  + - Fuzzy clustering
      * Fuzzy pattern recognition –
* Syntactic pattern recognition.
* Application of pattern recognition **(9hrs)**

## Text Books:

1. Rafael C Gonzalez and Richard E. Woods: “Digital Image Processing”, 4th Edition, 2018, Pearson Publication.
2. Sergios Theodoridis, Konstantinos Koutroumbas, “Pattern Recognition”, 5th Edition, 2018, Academic Press.

## Reference Books:

1. Scott. E. Umbaugh, “Digital Image Processing and Analysis”, 3rd Edition, 2017, CRC Press
2. M. Sonka Milan, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, 4th Edition, 2014, Cengage Learning
3. Rafael C. Gonzalez, Richard Eugene Woods, “Digital Image Processing Using MATLAB”, 2nd Edition, 2013. Tata McGraw Hill Ed.
4. Chris Solomon, Toby Breckon, “Fundamentals of Digital Image Processing: A Practical Approach with Examples”.
5. W. K. Pratt, Introduction to “Digital Image Processing”, 2014, CRC Press.
6. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Ed, 2012, John Wiley & sons
7. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, 2016, Springer.