

CS437 FUNDAMENTALS OF IMAGE PROCESSING (ELECTIVE III)

Course Description & Objective:

To introduce to students the analytical tools and methods, which are currently used in digital image processing as applied to image information for human viewing. Students will learn to apply these tools in the laboratory in image restoration, enhancement, compression and segmentation.

Course Outcomes:

- Understand image formation and the role human visual system plays in perception of gray and color image data.
- Get broad exposure to and understanding of various applications of image processing in industry, medicine and defences.
- Learn the signal processing algorithms and techniques in image enhancement and image restoration.
- Acquire an appreciation for the image processing issues and techniques and be able to a IV Year IV Year apply these techniques to real world problems.
- Be able to conduct independent study and analysis of image processing problems and techniques.

UNIT I - Digital Image Fundamentals

Fundamental steps in Digital Image Processing, Components of an Image Processing systems, Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, basic relationship between pixels, basic geometric transformations, Introduction to Fourier Transform and DFT, Properties of 2D Fourier Transform, FFT Separable Image Transforms, Walsh, Hadamard, Discrete Cosine Transform.

UNIT II - Image Enhancement

Spatial Domain methods, Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing,

sharpening filters, Laplacian filters, Frequency domain filters: Smoothing, Sharpening filters, Homomorphic filtering.

UNIT II - Image Restoration

Model of Image Degradation/restoration process, Noise models, Inverse filtering, Least mean square filtering, Constrained least square filtering, Blind image restoration, Pseudo inverse, Singular value decomposition.

UNIT IV - Image Segmentation

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V - Image Compression

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

TEXTBOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing, Pearson', Second Edition, 2004.
2. Milan Sonka et al, 'IMAGE PROCESSING, ANALYSIS AND MACHINE VISION', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

REFERENCES:

1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2004.
3. D.E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, Digital Image Processing , John Wiley, New York, 2002
5. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson 2002.