FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

(Elective Subject)

Course Code:	10B1WEC734	Semester:	7th Semester, B.Tech. (ECE)
Credits:	3	Contact Hours:	L-3, T-0, P-0

Course Objectives
1. Describe and explain basic principles of digital image processing.
2. Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).
3. Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).
4. Assess the performance of image processing algorithms and systems.

Course Outcomes
This course provides the knowledge of analog and digital communication system analysis and design. After study through lectures and assignments, students will be able to
1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Digital Image Fundamentals: Fundamental steps in DIP, Components of digital image processing, elements of visual perception, Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition, image formation model, definition and some properties of two dimensional system, Discrete 2D convolution, 2D discrete Fourier transform and its properties, optical and modulation transfer function, Spectral density function. Sampling and quantization of images, Two dimensional sampling theory, representation of digital image, Spatial and gray level resolution, zooming and shrinking, some basic relationships between pixels.	Gonzalez and Woods Chapter – 1 Pg. 1-29 Chapter – 2 Pg. 34-70 Chapter – 4 Pg. 149-166	7

2.	Image Enhancement in the Spatial Domain: Gray Level Transformations, Piecewise linear transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filters, Use of first order and second order derivative in enhancement.	Gonzalez and Woods Chapter – 3 Pg. 76-130	7
3.	Image Enhancement in the Frequency Domain: Two dimensional Fourier Transform, properties of frequency domain, correspondence between filtering in spatial and frequency domain, Smoothing and Sharpening frequency domain filters, Homomorphic Filtering.	Gonzalez and Woods Chapter – 4 Pg. 148-193	7
4.	Image Restoration: Model of the Image Degradation/Restoration Process, Noise Models, Noise reduction in spatial domain and frequency domain, Inverse filtering, Wiener filtering.	Gonzalez and Woods Chapter – 5 Pg. 221 - 261	7
5.	Image Compression: Fundamentals of Image Compression, Image compression models, concepts of Information Theory, Fundamental coding theorems, Estimation of entropy, Variable length coding, Huffman coding, Near optimal variable length coding, Near optimal variable length coding, Arithmetic coding, constant area coding, run length coding, image compression standards (JPEG, JPEG2000).	Gonzalez and Woods Chapter – 8 Pg. 411- 456	7
6.	Image Segmentation: Detection of Discontinuities (point, line edge), Edge Linking and Boundary Detection, Thresholding, Basic global Thresholding, Adaptive Thresholding, Region-Based Segmentation, region growing, splitting and merging.	Gonzalez and Woods Chapter-10 Pg. 568-615	6
		Total Number of Lectures	**41**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. R.C.Gonzalas and R.E.Woods, Digital Image Processing, Prentice Hall, 3rd Ed.

Reference Books

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2. S.Sridhar, Digital Image Processing, Oxford University Press.