INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

DIGITAL SIGNAL AND IMAGE PROCESSING								
VI Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD31	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Applied Mathematics								

I. COURSE OVERVIEW:

The aim of this course is to enhance the understanding of fundamental knowledge in signal and image processing needed for future technological advances. The framework prepares students to engage in scientific questioning and extend thinking to investigations. The concepts cover basic knowledge on classification of signals, signal transforms, and the current topics in the fields of image processing. This knowledge helps to develop the ability to apply the principles in many technological sectors such as speech signal processing, morphological processing, biomedical signal and image processing, etc.

II. COURSES OBJECTIVES:

The students will try to learn

I. Types of signals along with their properties and use of convolution correlation properties on signals.
II. To implement discrete-time systems, recursive and non-recursive realizations with Z-transforms and their properties
III. Detailed knowledge of the founding principles of digital image processing, and understanding of how the various fundamental equations both operate and are constructed.
IV. The techniques for image enhancement, restoration, and apply algorithms for edge detections.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Illustrate the concept of discrete time signals and systems for analyzing the response of LTI system in time domain and frequency domain

CO 2 Construct the Decimation-in-time fast fourier transform and decimation-infrequency fast Fourier transform for reducing computational complexity of DFT.

CO 3 Implement the digital filters and their realization structures using various transformation technique

CO 4 Analyze the performance characteristics of digital filters to meet expected system specifications using MATLAB.

.CO 5 Construct image intensity transformation and filtering techniques for image enhancement in the spatial and frequency domain.

CO 6 Analyze the image restoration in the spatial and frequency domains to deal with noise models for removing degradation from a given image

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (10)

Discrete time signal definition; Signal classification; Elementary signals; Transformation of elementary signals; Concept of digital frequency; Discrete time system definition; System classification; Linear time invariant (LTI) system; Properties of the LTI system; Time domain analysis of discrete time systems; Impulse response; The convolution sum; Methods of evaluating the convolution sum; Filtering using overlap-save and overlap-add method

MODULE –II: DISCRETE FOURIER TRANSFORM AND EFFICIENT COMPUTATION (09)

Introduction to discrete time Fourier transform (DTFT); Discrete Fourier transform (DFT) definition; Properties of DFT; Linear and circular convolution using DFT; Fast-Fourier-transform (FFT): Direct computation of DFT; Need for efficient computation of the DFT (FFT algorithms); Radix-2 FFT algorithm for the computation of DFT and IDFT using decimation-in-time and decimation-in-frequency algorithms; General Radix-N FFT.

MODULE –III: FILTER DESIGN TECHNIQUES (10)

Analog filters: Butterworth filters; Chebyshev type-1 and type-2 filters; Analog transformation of prototype LPF to HPF/BPF/BSF. Transformation of analog filters into equivalent digital filters using impulse invariant method and linear transform method.

Design of linear phase FIR filters windowing and frequency sampling methods; Equi-ripple linear phase FIR filters. Comparison of FIR and IIR.

MODULE –IV: DIGITAL IMAGE FUNDAMENTALS (09)

Digital image processing fundamental steps, image sampling and quantization, some basic relationships-Neighbors, distance, connectivity, Translation, Scaling, Rotation and Perspective Projection of image, Linear and Non-Linear Operations, Image transforms Some basic Gray Level Transformations, Histogram Processing, Image Enhancement Methods, Spatial Enhancement Methods, Frequency Domain Filters - Homomorphic Filtering.

MODULE –V: DIGITAL IMAGE RESTORATION AND COMPRESSION (10)

Image Degradation / Restoration Process, Noise Models, Spatial Filtering for Image Restoration, Frequency Domain Filtering, Linear Position-Invariant Degradations, Inverse filtering, Wiener filtering, Geometric Transformations.

Compression: Coding Interpixel and Psychovisual Redundancy, Image Compression models, Compression standards, Entropy, Error-Free Compression, Lossy Compression, LZW coding, Transform Coding, JPEG-2000 encoding, Lossless predictive coding, Lossy predictive coding.

V. TEXTBOOKS:

1. Oppenheim, Alan V., and Ronald W. Schafer. Digital Signal Processing. Prentice Hall, 1975. ISBN: 9780132146357.
2. Digital Image Processing Rafael C. Gonzalez.

VI. REFERENCE BOOKS:

1. Lyons, R.G. (2010). Understanding digital signal processing. Prentice Hall (3rd ed.).
2. Lathi, B. P. Signals, Systems and Communication. John Wiley and Sons, 1965.
3. Stein, J. (2000). Digital signal processing – a computer science perspective. Wiley.
4. Algorithms for Image Processing and Computer Vision James R. Parker.

VII. ELECTRONICS RESOURCES:

1 NPTEL: Digital Image Processing
2 NPTEL: Introduction To Adaptive Signal Processing
3 NPTEL: Signal Processing Techniques and Its Applications
4 https://nptel.ac.in/courses/117102060
5. https://archive.nptel.ac.in/courses/108/101/108101174/
6. https://archive.nptel.ac.in/courses/108/105/108105055/
7. https://nptel.ac.in/courses/108106151

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations