# DIGITAL SIGNAL PROCESSING

VI Semester: ECE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AECB23	Core	L	Т	Р	С	CIA	SEE	Total
		2	1	0	3	30	70	100
Contact Classes: 30	<b>Tutorial Classes: 15</b>	Practical Classes: Nil			Total Classes: 45			

### I. COURSE OVERVIEW:

This course provides the design of discrete-time systems and analytical tools to analyze the discrete signals and systems. It focuses on the classification of discrete-time signals and systems, linear time- invariant systems, discrete fourier transform, fast fourier transform algorithms, digital filter design and multi rate signal processing. Digital signal processing applications are used in speech processing, image processing, audio and video data compression, communication systems.

### **II. OBJECTIVES:**

### The course should enable the students to:

- I The classification and analysis of discrete time signals and systems in time and frequencydomain.
- **II** The design and realization structures of finite and infinite impulse response filters andmulti rate filters.
- III The implementation of digital filter algorithms using MATLAB tool..

### **III. COURSE OUTCOMES**

#### After successful completion of the course, students should be able to:

- CO 1 **Illustrate** the concept of discrete time signals and systems for analyzing the Understand response of LTI system in time domain and frequency domain.
- CO 2 **Construct** the Decimation-in-time fast fourier transform and Apply Decimation-in-frequency fast Fourier transform for reducing computational complexity of DFT.
- CO 3 **Implement** the digital filters and their realization structures using various Apply transformation techniques.
- CO 4 Analyze the performance characteristics of digital filters to meet expected system Analyze specifications using MATLAB.
- CO 5 **Interpret** the efficient implementation of sample rate conversion of digital signals Understand to interface the digital systems with different sampling rates.
- CO 6 **Identify** the errors in analog to digital conversion for tolerating finite wordlength Apply effects.

# IV. SYLLABUS:

# MODULE - I REVIEW OF DISCRETE TIME SIGNALS AND SYSTEMS Classes: 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; Realization of digital filters: Concept of IIR and FIR filters; Realization structures for IIR and FIR filters using direct form-I and direct form-II, cascade, lattice and parallel.

MODULE - II	DISCRETE FOURIER TRANSFORM AND EFFICIENT COMPUTATION	Classes: 08				
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	IIR FILTERS	Classes: 09				
Analog filters: Bu LPF to HPF/BPF/	Analog filters: Butterworth filters; Chebyshev type-1 & 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 bilinear transform method; MATLAB programs of IIR filters.						
<b>MODULE - IV</b>	SYMMETRIC AND ANTISYMMETRIC FIR FILTERS	Classes: 09				
Characteristics of FIR Digital Filters, Frequency response, Design of FIR Filters: Fourier Method. Digital Filters using Window Techniques, Frequency Sampling technique, Comparison of IIR & FIR filters						
MODULE - V	APPLICATIONS OF DSP	Classes: 09				
Multirate signal processing; Decimation; Interpolation; Polyphase structures for decimation and interpolation filters; Structures for rational sampling rate conversion; Applications of multirate signal processing for design of phase shifters, interfacing of digital systems with different sampling rates, sub band coding of speech signals. Analysis of finite word length effects: Representation of numbers; ADC quantization noise, coefficient quantization error, product quantization error, truncation & rounding errors; Limit cycle due to product round-off error; Round-off noise power; Limit cycle oscillations due to overflow in digital filters; Principle of scaling; Dead band effects.						
<ol> <li>Digital signal processing, Principles, Algorithms and Applications, John G. Proakis, Dimitris G. Manolakis , Prentice Hall, 4<sup>th</sup> Edition,2007.</li> <li>Digital signal processing, A computer base approach ,Sanjit K Mitra, McGraw-Hill Higher Education,</li> </ol>						
<ul> <li>4<sup>ar</sup> Edition, 2011.</li> <li>3. DSP-A Practical Approach Emmanuel C, Ifeacher, Barrie. W. Jervis, Pearson Education, 2<sup>nd</sup> Edition, 2002.</li> <li>4. Discrete Time Signal Processing, A.V. Opperhaim, P.W. Schoffen, PHL 2<sup>nd</sup> Edition 2006.</li> </ul>						
Reference Books:						
<ol> <li>Digital signal processing: fundamentals and applications ,Li tan, Elsevier Science &amp;.Technology Books, 2<sup>nd</sup> Edition, 2008.</li> <li>FundamentalsofDigitalsignalprocessingusingMatlab ,RobertJ.schilling,Sandra.L.harris,Thomson Engineering, 2<sup>nd</sup> Edition,2005.</li> <li>Digitalsignalprocessing ,Salivahanan,Vallavaraj,Gnanapriya,McGraw-HillHigherEducation,2<sup>nd</sup> Edition, 2009.</li> </ol>						
Web References:						
<ol> <li>https://nptel.ac.in/courses/117102060/</li> <li>https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/</li> </ol>						
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<b>E-Text Books:</b>			

- $1. \ https://b-ok.cc/s/?q=ebook+for+digital+signal+processing$
- 2. https://www.e-booksdirectory.com/details.php?ebook=4117
- 3. http://freecomputerbooks.com/Design-and-Architectures-for-Digital-Signal-Processing.html