DIGITAL SIGNAL PROCESSING

III Year B.Tech. II-Sem

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	TOTAL
23EC607	Core	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: Nil				Total Classes:48		

Pre-requisites: Laplace Transforms, Numerical Methods and Complex variables, Control Systems

Course Objectives:

- Provide foundational knowledge for the analysis and processing of digital signals.
- Explore the relationships between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis.
- Introduce real-world signal processing applications while studying the design and structures of digital filters, including IIR and FIR, and addressing finite word length effects.

Course Outcomes: At the end of this course, students will be able to:

- Carry out simulation of DSP system and abilities towards DSP processor-based implementation of DSP systems.
- Analyze Finite wordlength effect on DSP systems and applications of FFT to DSP.
- Implement adaptive filters for various applications of DSP.
- Perform and interpret frequency response analysis and power spectrum estimation of signals using appropriate tools.
- Develop and test DSP-based applications such as DTMF signal generation, noise removal, and audio signal analysis using MATLAB and DSP processors.

UNIT-I: Introduction: Realization of Digital Filters: Introduction to Digital Signal Processing: Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Normalized Frequency**,** Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation**,** Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems Applications of Z – Transforms, Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Frequency Response of Stable Systems, Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

UNIT-II: Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z-Transform.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT, and FFT with General Radix-N

UNIT-III: IIR Digital Filters: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

UNIT-IV:

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency Response, and Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters.

UNIT-V:

Multi-Rate Digital Signal Processing: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion, Conversion of Band Pass Signals, Concept of Resampling, Applications of Multi Rate Signal Processing.

Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round off Noise, Methods to Prevent Overflow, Tradeoff between Round Off and Overflow Noise, Measurement of Coefficient Quantization Effects through Pole-Zero Movement, Dead Band Effects.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009.

REFERENCE BOOKS:

1. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009
2. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
3. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
4. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachorand Barrie W. Jervis, 2nd Edition, Pearson Education, 2009