3EC12: DIGITAL SIGNAL PROCESSING
CREDITS - 3 (LTP: 3,0,0)

Course Objective:

To provide a thorough understanding and working knowledge of various transform techniques to analyze discrete time signals and systems in time and frequency domain, design of digital filters, advanced DSP techniques and DSP processor with its applications.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Content:

Unit No.	Topics	Teaching Hours
1.	**Discrete-Time Signals and Systems :** Introduction to DSP, Discrete-Time Signals: Sequences, Discrete-Time Systems, Linear Convolution and its Properties, Correlation of Discrete-Time Systems, Representation of Sequences by Discrete Time Fourier Transform, (DTFT), Properties of DTFT, Inverse DTFT.	05
2.	**The z-Transform and Analysis of LTI Systems :** Introduction, The Z-transform, Properties of ROC for Z-transform, Z-transforms Properties, The Inverse Z-transform, Analysis of LTI Systems using Z-transform, System Stability and Z-transform, The Frequency Response of LTI Systems, System Functions for Systems with LCCDE, Frequency Response of Rational System Functions, Relationship between Magnitude & Phase, All Pass Systems, Inverse Systems, Minimum, Maximum and Mixed Phase Systems, Systems with Linear Phase.	08
3.	**Structures for Discrete-Time Systems :** Introduction, Block Diagram and Signal Flow Graph Representations of LCCDE, Basic Structures of IIR Systems, Direct Forms, Cascade Forms, Parallel Forms, Transposed Forms, Direct and Cascade Form Structures for FIR Systems, Linear Phase FIR Structure, Effects of Co-efficient Quantization.	05
4.	**Filter Design Techniques :** Introduction, Fundamentals of Filter Design, Ideal Filters and Approximations, Design of Discrete-Time IIR Filters from Continuous-Time Filters, Approximation of Derivatives, Impulse Invariance and Bilinear Transformation Methods, Frequency Warping Concept, Design of Analog Butterworth and Chebyshev Filters, Design of FIR filters by Windowing Techniques, Comparison between IIR and FIR Filters.	08

Unit No.	Topics	Teaching Hours
5.	**Discrete Fourier Transform and Fast Fourier Transform:** Introduction, Representation of Periodic Sequences: The Discrete Fourier Series (DFS) and Its Properties, Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform (DFT), Properties of DFT, Linear Convolution using DFT, Linear Filtering Methods Based on DFT, The Discrete Cosine Transform, Efficient Computation of DFT: FFT Algorithms, Radix-2 and Radix-4 FFT Algorithms, Bit Reversal, The Goertzel Algorithm.	08
6.	**Advance DSP Techniques :** **Multirate Digital Signal Processing :** Introduction, Decimation, Interpolation, Sampling Rate Conversion by Rational Factor. **Optimal and Adaptive Filters :** Introduction, Minimum Mean Square Error and Linear Minimum Mean Square Error Criteria, Wiener Filter, Linear Prediction, LMS Algorithm, Adaptive Filter Applications.	07
7.	**Architecture of DSP Processors & Applications :** Introduction, Characteristics of DSP algorithms and Hardware Requirements, Von Neumann Architecture, Harvard Architecture, Parallelism and Hardware Units of Typical Digital Signal Processor, Architectural details of TMS320C6x.	04
	Total	**45**

List of References:

1. Oppenheim, Schafer & Buck, *"Discrete Time Signal Processing"*, 2nd Edition Pearson Education Publication, 2003
2. Proakis & Manolakis, *"Digital Signal Processing: Principles, Algorithm & Application",* 4th edition, Pearson Education, 2006
3. S. K. Mitra, *"Digital Signal Processing – A Computer Based Approach",* 3rd Edition, Tata McGraw Hill, 2006
4. S. Salivahanan, *"Digital Signal Processing"*, 3rd Edition, McGraw Hill Education, 2014

Course Outcomes (COs):

1. Understanding of frequency domain analysis of discrete time signals.
2. Use of various transforms to acquire knowledge about discrete time systems.
3. Design and analysis various digital filters for processing of discrete time signals.
4. Employ multiple sampling rates in the processing of digital signals.
5. Interpret the necessity of adaptive filters in communication applications.
6. Understand the key architectural features of Digital Signal Processor.