Course Type	Course Code	Name of Course	L	T	P	Credit
DC	ECC302	Digital Signal Processing	3	0	0	9

Course Objective

Objective of this course is to be able to obtain discrete-time signal from a continuous-time signal, design and implement a system for processing the signal to meet a given set of specifications, to obtain frequency-domain description of a signal using Fourier transform along with its implementation, limitation of Fourier transform and the way Wavelet transform overcomes it.

Learning Outcomes

Upon successful completion of this course, students will know :

- Sampling of a continuous-time signal to obtain the corresponding discrete-time signal
- Design of digital filters – both FIR and IIR
- Implementation of digital filters with different structures
- Discrete Fourier Transform (DFT) along with its computation and use in spectral analysis of signals
- Effects of finite word-lengths
- An idea about Digital Signal Processors
- Multirate Signal Processing and introduction to wavelets

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Review of discrete time signals and systems; Discrete time Fourier transform; Sampling, Quantization and discrete-time processing of continuous time signals.	7	Recapitulation of concepts related to discrete time signals and systems; Acquaintance with the issues related to conversion of continuous-time signal to the corresponding discrete-time signal
2	Digital Filter design techniques: Design of digital IIR filters: Impulse invariant and bilinear transformation techniques for Butterworth and Chebyshev filters; Design of FIR filters: Windowing, frequency sampling filter design, optimum approximations of FIR filters.	9	Acquire ability to design digital filters (both FIR and IIR filters) to meet a given set of specifications
3	Structures for discrete-time systems: Basic structures for FIR and IIR systems (direct, parallel, cascade and polyphase forms), linear phase structure for FIR filters, ladder and lattice structures. Signal flow graph representation, transposition theorem.	7	Obtain different structures for implementation of a digital filter with given system function
4	Discrete Fourier Transform (DFT): DFT relations, DFT properties, Fast Fourier transform (FFT) algorithms (radix-2, decimation-in-time, decimation-in-frequency), Goertzel algorithm, linear convolution using DFT, Spectral analysis using DFT.	7	Know about the DFT, its properties, algorithms for computation and applications
5	Finite wordlength effects in digital filters: Fixed and floating point representation of numbers, quantization noise in signal representations, finite wordlength effects in coefficient representation, roundoff noise, SQNR computation and limit cycle.	7	Know how use of finite wordlength affects performance of the digital filters
6	Introduction to Multirate signal processing: Decimation, interpolation, polyphase decomposition; Introduction to Wavelets.	5	Know about changing the sampling rate of a signal, efficient implementation of filters involved in sampling rate change, the issues related to time & frequency localization of a signal

Textbook:

1. Oppenheim, A.V. and Schafer, R.W., "Discrete-time Signal Processing", Pearson Education.

Reference Books:

1. Proakis, J.G. and Manolakis, D.G., "Digital Signal Processing", Pearson Education.
2. Mitra, S.K., "Digital Signal Processing: A Computer-based approach", McGraw Hill
3. Hayes, M.H. (adapted author: Subrata Bhattacharya), "Schaum's Outlines Digital Signal Processing", McGraw Hill India.