

Lecture: 4 periods/week  
Tutorial: 1 period /week

Internal assessment : 30 marks  
Semester end examination: 70 marks

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**Course Objectives:**

- To study DFT and FFT and its computation, design techniques for digital IIR and FIR filters and about Multirate Digital Signal Processing.

**Learning Outcomes:**

At the end of this course, the students will be able to understand the

- Structures of Discrete time signals and systems
- DFT and FFT Computation
- Frequency Response and design of FIR and IIR filters.
- Sampling rate conversion -Interpolation and decimation

UNIT-I

**Introduction:** Introduction to Digital signal processing, Discrete time Signals, Discrete time systems, Linear Time-Invariant Systems, Analysis of LTI systems, Causality and Stability, Linear Constant Coefficient Difference equations.

UNIT-II

**Applications of Z – Transforms:** System Function  $H(z)$  of Digital Systems, Stability Analysis, Structure and Realization of IIR systems, Structure and Realization of FIR systems.

UNIT-III

**Discrete Fourier Transform (DFT):** Introduction to DFT, Properties of DFT, Circular Convolution, Linear convolution of sequences using DFT, Computation of DFT, Relation between Z-transform and DFT.

UNIT-IV

**Fast Fourier Transforms (FFT):** Introduction, Radix-2 Decimation-In-Time (DIT) and Decimation-In-Frequency (DIF) FFT Algorithms, Inverse FFT.

UNIT-V

**IIR Digital Filter Design Techniques:** Design of IIR Filters from analog filters, Analog Filters Approximations (Butterworth and Chebyshev Approximations), Frequency Transformations, General Considerations in Digital Filter Design, Bilinear Transformation Method, Step and Impulse Invariance Techniques.

UNIT-VI

**Design of FIR Filters:** Characteristics of FIR Digital Filters, frequency response of FIR filters, Design of FIR Digital Filters using Fourier Series Method, Window Function Techniques, Frequency Sampling Method, Comparison of IIR and FIR Filters.

UNIT-VII

**Multirate Digital Signal Processing :** Decimation, Interpolation, sampling rate conversion, Implementation of sampling rate conversion.

UNIT-VIII

**Applications:** Applications of FFT in Spectrum Analysis and Filtering, Application of DSP in Speech Processing.

**Learning resources**

**Text books:**

1. Proakis, J. & D. G. Manolakis “Digital Signal Processing: Principles, Algorithms and Applications”, 4th Edition, Pearson Education . (2007).
2. Alan V. Oppenheim and Ronald W. Schaffer: Digital Signal Processing, PHI.

**Reference Books:**

1. Fundamentals of Digital Signal Processing, Lonnie C Ludeman, John Wiley & Sons, 2003
2. Digital Signal Processing “A – Computer Based Approach”, Sanjit K Mitra, Tata Mc Graw Hill 2nd Edition, 2003
3. Application of Digital Signal Processing, Raddar and Rabiner