

# Discrete Time Signal Processing

B.E. Sem. VII [EXTC]

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## EVALUATION SYSTEM

|                | Time   | Marks |
|----------------|--------|-------|
| Theory Exam    | 3 Hrs. | 100   |
| Practical Exam | –      | –     |
| Oral Exam      | –      | 25    |
| Term Work      | –      | 25    |

**Objective :** To develop a thorough understanding of the central elements of discrete Time signal processing theory and the ability to apply this theory to real-world signal processing applications.

## SYLLABUS

### 1. Transform analysis of LTI system

Frequency response of LTI systems, Phase Distortion and delay, all pass systems, minimum, maximum and mixed phase systems, Linear phase filters, causal generalized linear phase systems (pole zero plots), symmetric and antisymmetric filters, Low pass, high pass and Band pass filters, digital resonators, comb filter, notch filter, all pass filters, digital sinusoidal oscillators.

DFT and its Properties, Linear filtering based on DFT, Frequency analysis of signals using DFT, Filtering of Long data sequences.

### 2. Computation of DFT

Radix-2, Radix-4 Fast Fourier Transform, DIT FFT, DIF FFT, IFFT, Split radix FFT Linear filtering and correlation using FFT, Goertzel Algorithm, Chirp-Z Transform.

### 3. Finite Impulse Response (FIR) Filter Design

FIR Filter Design- Window method, Frequency sampling method, Optimum equiripple Linear phase FIR, FIR Differentiator, Finite word length effect in FIR digital filters. Frequency Transformation. Realization Structures for FIR filters- Direct form structure, Cascade, Frequency Sampling Structure, Lattice Ladder structure. Structures for Linear phase FIR filters.

### 4. Infinite Impulse Response Filter Design

Design of IIR Filters- Impulse invariant method, Matched Z- Transform Method, Bilinear Transformation method. Butterworth filter, Finite wordlength effects in IIR Filters. Frequency Transformation- Low pass to High pass, Band Pass and band reject filters. Realization Structures for IIR Filters – Direct form structures, Cascade and parallel realization structures for higher order structures, Lattice Ladder structure. Application examples in Telecommunication- Touch tone generation and reception for digital Telephones, Digital telephony: Dual tone multifrequency detection using Goertzel algorithm, Clock recovery for data communication

### 5. Multi rate Signal Processing

Sampling rate reduction: decimation by integer factors, Sampling rate increase: interpolation by integer factors, sampling rate conversion by non integer factors, Multistage approach to sampling rate conversion, Polyphase implementation of interpolators. Sample rate conversion using poly phase filter structure. Applications of Multirate signal Processing- Interfacing of Digital Systems with different Sampling rates, Filter Banks, Subband coding of speech signals.

### 6. Telecommunications applications of DTSP

Digital Cellular mobile telephony, Set top box for digital television reception, Adaptive television echo cancellation. Applications to Radar

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**Reference :**

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3. Shaum Outlines, Monson Hayes, Adapted (*Subrata Bhattacharya*) Tata McGraw Hill.
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5. Discrete Time Signal Processing (*Salivahnan, A. Vallavaraj, C. Gnanapriya*) Second Edition, Mc Graw Hill.
6. Digital Signal Processing, 2nd edi. (*Shailaja Apte*) Wiley India.
7. Fundamentals of Digital Signal Processing using MATLAB (*Robert Schilling, Sandra Harris*) Cengage Learning.
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9. Digital Signal Processing (*Chen*) Oxford University Press
10. A Practical Approach to Digital Signal Processing (*Padmanabhan K.*) New Age International.
11. Digital signal processing :system analysis and design (*Diniz ,da sillva, Netto*) Cambridge university press.
12. Digital Signal Processing (*Ashok Ambardar*) Cengage Learning Publication.

