

DIGITAL SIGNAL PROCESSING

Objective of the course is to familiarize students about MATLAB programming for Digital Signal Processing. The course is designed to familiarize students with practical implementation of various theoretical ideas learned from basic courses on “signal and systems” at undergraduate level and to aid in their understanding. This course focuses mainly on MATLAB implementation of various concepts and is designed to lack in mathematical rigour as the course will not provide any mathematical proof or derivation. The course focuses on the algorithm for software implementation of various DSP concepts.

OUTLINE OF THE COURSE

S. No.	Topic	Minimum number of Hours
1	Discrete Time signal and system	4
2	Sampling continuous time signal	4
3	Z-transform	6
4	Transform analysis of LTI systems	6
5	Structure of DT systems	6
6	Filter Design	8
7	Discrete Fourier Transform	6

LECTURE : 40 hrs

PRACTICE/TUTORIAL : 40 hrs

PROJECT : 40 hrs

TOTAL : 120 hrs

DETAILED SYLLABUS

1. Discrete-time signals and systems

Discrete-time signals as sequences, Properties of discrete-time systems, Linear time-invariant systems, Difference equations, Frequency domain and Fourier transforms

2. Sampling continuous-time signals

Frequency domain representation of sampling, Reconstruction, A/D and D/A conversion

3. z-Transforms

Definition of the z-transform, Convergence, Inverse z-transform, Properties

4. Transform analysis of LTI systems

Frequency response, System functions, Analysis of magnitude and phase

5. Structure for d-t systems

Structures for FIR and IIR filters, Quantization and noise

6. Filter design

IIR systems, FIR windowing methods, FIR optimal approximation methods

7. Discrete Fourier Transforms

DFT, Discrete cosine transform, Fast Fourier transform

RECOMMENDED BOOKS

- 1. Monsoon H. Hayes, "Schaums Outline of Digital Signal Processing", Schaum outline Series , Tata McGraw-Hill, 2nd Edition**
- 2. John G. Proakis," Digital Signal Processing using MATLAB"**
- 3. Robert A. Schilling," Introduction to Digital Signal Processing using MATLAB (English)" 2nd Edition**

ASSIGNMENTS

- 1) Write a program in MATLAB to generate the following waveforms (Discrete – Time signal and Continuous – Time signal) DT:
 1. Unit Impulse sequence, 2. Unit step sequence, 3. Unit Ramp sequence, 4. Sinusoidal sequence, 5. Exponential sequence, 6. Random sequence, CT:
 1. Pulse signal, 2. Unit step signal 3. Ramp signal 4. Sinusoidal signal, 5. Exponential signal, 6. Random signal
- 2) Write a program in MATLAB to study the basic operations on the Discrete – time signals. (Operation on dependent variable (amplitude manipulation) and Operation on independent variable (time manipulation))
- 3) To check for linearity, Causality and stability of various systems given bellow: Linearity: System1 $n.X(n)$, System2 $An.X^2(n)+B$ System3: $\log(X), \sin(x), 5X(n)$...etc Causality: System1 $U(-n)$ System2 $X(n-4)+U(n+5)$ Stability: System1 $Z / (Z^2 + 0.5 Z + 1)$
- 4) Write a MATLAB Script to perform sampling rate conversion for any given arbitrary sequence (D.T) or signal (C.T) by interpolation, decimation, upsampling, downsampling and resampling (i.e. fractional value)
- 5) Write a MATLAB Script to perform discrete convolution (Linear and Circular) for the given two sequences and also prove by manual calculation.
- 6) Write a MATLAB program to perform the Discrete Fourier Transform for the given sequences.
- 7) Write a MATLAB Script to compute Discrete Fourier Transform and Inverse Discrete Fourier Transform of the given sequence using FFT algorithms (DIT-FFT & DIF-FFT) .
- 8) Write a MATLAB Script to design a low pass FIR filter using Window Method for the given specifications .
- 9) Write a MATLAB Script to design Analog Butterworth filters for the given specifications.
- 10) Write a MATLAB Script to design Analog Chebyshev filter for the given specifications.
- 11) Write a MATLAB Script to design Butterworth and Chebyshev low pass filters using Bilinear Transformation Impulse Invariant Transformation.
- 12) Write a MATLAB Script to find the time domain response (impulse response and step response) for the given FIR and IIR systems (filters).
- 13) Write a MATLAB Script to find the frequency domain response (magnitude response and phase response) for the given FIR and IIR systems (filters).