DIGITAL SIGNAL PROCESSING (THEORY) EE-332

Pre-requisite: Signals & Systems (EE-230)
Credit Hours 03
Contact Hours 48

RECOMMENDED BOOKS

- Discrete-Time Signal Processing by Alan V. Oppenheim, Ronald W. Schafer.Third edition

REFERENCE BOOKS

- Digital Signal Processing by John G. Proakis And Dimitris G. Manolakis
- Introduction to Signal Processing by Sophocles J. Orfanidis
- Digital Signal Processing: A Computer-Based Approach by Mitra
- Digital Signal Processing by Emmanuel C. Ifeachor and Barrie W. Jervisignals, Systems, and Transforms by Charles L. Phillips

OBJECTIVE OF COURSE

The objective of this course is to familiarize with fundamental principles of digital signal processing. Overview of Discrete-time systems including difference between continuous, discrete and digital systems. Fundamental concepts of Linear, discrete and LTI systems and their properties. Review of linearity, stability, causality, convolution, circular convolution and correlation. Discrete time fourier transform, discrete fourier series and discrete fourier transform. z-transform, its properties, z-tranform of FIR and IIR systems, Application of z-transform for analysis of Linear Shift Invariant systems, system stability, effect of a pole and a zero on magnitude response of a FIR and IIR system, min-phase and all-pass systems, pole-zero location of linear phase FIR systems, Circular Convolution, Discrete Fourier Transform, Fast Fourier Transform, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters.

S.NO	CLO/PLOs MAPPING	DOMAIN	PLO
			01
01	**Apply** the knowledge of mathematics and engineering to analyze discrete time signals.	C3	
02	**Apply** the principles to solve discrete time convolution problems, and perform time and frequency domain	C3	02

	conversion.		
03	**Analyze** the digital systems using z-transform and Discrete Time Fourier transforms	C4	02
04	**Design** FIR and IIR filters using a variety of techniques	C5	03
05	**Use MATLAB** tools to analyze and process discrete time signals and systems.	C3	05

COURSE CONTENTS

Introduction

- Signals, Systems, and Signal Processing
- Types of Signals
- The concept of the frequency
- Analog-to-Digital and Digital-to-Analog Conversion

Discrete Time Signals and Systems

- Discrete-time Signals, Discrete-time Systems
- Analysis of Discrete-time Linear and Time invariant systems
- Linear Time-Invariant Systems and properties
- Discrete-time systems described by Difference Equations
- Implementation of the Discrete-time Systems
- Correlation of Discrete-time Signals

The Z- and Fourier transform and its Application to the Analysis of LTI Systems

- The z-transform, graphical presentation and mathematical modeling
- Properties of the z-transform and pole zero maps
- Rational z-transform
- Inverse z-transform
- Analysis of LTI Systems in the z-transform
- The one sided z-transform, two sided Z-transform

Frequency Analysis of Signals

- Frequency Analysis of Continuous –Time Signals
- Frequency Analysis of Discrete-Time Signals
- Frequency Domain and Time –Domain Signal Properties
- Properties of the Fourier transform for Discrete-Time Signals

Frequency-Domain Analysis of LTI Systems

- Frequency -Domain Characteristics of LTI Systems
- Frequency response of LTI Systems
- Correlation Functions and Spectra at the Output of LTI Systems
- LTI Systems as Frequency-Selective Filters
- Inverse Systems and Deconvolution

Sampling and Reconstruction of Signals

- Ideal Sampling and Reconstruction of Continuous –Time Signals
- Discrete Time Processing of the Continuous –Time Signals
- Analog-to-Digital and Digital-to-Analog Converters
- Sampling and Reconstruction of Continuous –Time Signals
- Oversampling A/D and D/A Converters

The Discrete-time Fourier transform

- Frequency-Domain Sampling: The Discrete Fourier Transform
- Properties of the DFT
- Linear Filtering Methods Based on the DFT
- Frequency Analysis of Signals Using the DFT
- Efficient Computation of the DFT: Fast Fourier Transform Algorithms

Digital Filters Design

- Design of FIR Filters
- Design of IIR Digital Filter
- Frequency Transformations

Multi-rate Signal Processing

- Decimation by a Factor M
- Interpolation by a Factor L
- Sampling Rate Conversion by a Rational Factor M/L
- Application of the Multi rate Signals Processing
- Digital Filter Banks