

CS010 504 DIGITAL SIGNAL PROCESSING

Teaching scheme

Credits:

3 hours lecture and 1 hour tutorial per week

Objectives:-

To introduce the principles and core areas of Signal Processing in a programmatic approach and explore the basic ideas on the applications of DSP in various fields of Science and Technology.

Pre-requisites:

CS 010 404 Signals and Communication Systems

Module 1: (15 Hrs)

Basic Concepts of DSP Systems:- Review of Continuous Time Signals and Discrete Time Signals, Elementary Discrete Signals, Operations on Discrete Signals- Operations on Independent and Dependent Variable(s)- Convolution Sum, Discrete Systems, Properties of Discrete Systems, Response of LTI Systems, Z-Transforms- Definition, Properties and Illustrative Examples, System Function, Discrete Time Fourier Transform(DTFT)- Definition, Properties and Illustrative Examples, Frequency Response

Module 2: (15 Hrs)

Discrete Fourier Transform(DFT): -Definition, Properties and Illustrative Examples, Relation between DFT, DTFT and Z Transforms, Complexity of DFT calculation, Divide & Conquer – Fast Fourier Transform (FFT)- Radix 2 Decimation in Time (DIT) and Decimation in Frequency (DIF) Algorithms, Composite Point DFT Computation, Circular convolution- Computation of Circular Convolution using DFT, Discrete Cosine Transform, Finite Word Length effects in DFT Computation

Module 3(12Hrs)

Digital Filter Design:- Need of Digital Filters, Types of Digital Filters- Theoretical and Realizable Frequency responses of Low Pass, High Pass, Band Pass and Band Stop Filters. Filter Design Specifications

Finite Impulse Response Filter:- FIR Filters with Linear Phase, Need of Linear Phase, Frequency response of Linear Phase FIR Filters, FIR Filter Design Methods- Fourier Series Method – Gibb's Phenomenon, Window Method- Design of FIR Filters using Rectangular, Triangular, Hamming, Hanning, Blackmann and Kaiser Windows, Frequency Sampling Method. Realization of FIR Filter- Direct, Linear Phase and Cascade Realisations. Finite Word Length effects in FIR Filter Design

Module 4: (10 Hrs)

Infinite Impulse Response Filters:- Steps in IIR Filter Design, Conversion of Analog Filter to Digital Filter- Impulse Invariant and Bilinear Transformations, Analog Filter Design Approximations- Butterworth and Chebyshev Approximations., Realization of IIR Filter- Direct, Cascade and Parallel Realizations. Finite Word Length effects in IIR Filter Design.

Module 5(8 Hrs)

Introduction to DSP Chips: - Basic Architecture of a DSP chip, Case Study: TMS 320, TigerSHARC Processors (Overview of Architecture and Features)

Applications of DSP:- Audio Signal Processing and Compression, Image Processing- JPEG Compression, Video Compression, Speech Processing and Recognition, Weather Forecasting, RADAR, (Brief idea only)

*Note: While discussing the Topics on Frequency response, DFT, Design of FIR and IIR Filters, illustrative example programs **must** be developed in **MATLAB/SCILAB** .*

Reference Books

1. Digital Signal Processing Andreas Antoniou Tata McGrawHill
2. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall of India Pvt. Ltd., 1997
3. Digital Signal Processing , A Computer Based Approach- S.K. Mithra TataMcGraw Hill
4. Oppenheim A. V., Schafer R. W., Discrete-Time Signal Processing, PrenticeHall/Pearson.