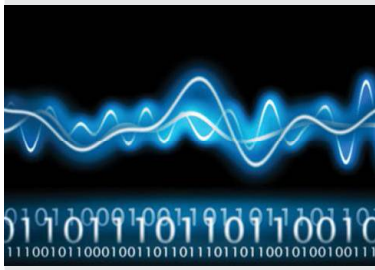
22EC308 DIGITAL SIGNAL PROCESSING



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Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Signals and systems.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of discrete time signals and systems found in engineering. The students will learn methods for characterizing z-plane analysis, the interrelationships of these analytic method, designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

INTRODUCTION TO DIGITAL SIGNAL PROCESSING:

Discrete time signals, systems and their classification, linear shift invariant systems, stability, and causality, linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems.

UNIT-2 **10L+10T+10P=30 Hours**

FOURIER SERIES AND FOURIER TRANSFORMS:

Discrete Fourier series representation of periodic sequences, Properties of discrete Fourier series, Discrete Fourier transforms: frequency domain sampling, linear convolution of sequences using DFT, Computation of DFT, Relationship of DFT to other transforms, Properties of DFT, Fast Fourier transforms (FFT) - Radix-2 FFT algorithm, Inverse FFT.

PRACTICES:

- Find the output y(n) for an input x(n), for the discrete time system represented by impulse response h(n).
- Compute Linear Convolution for two sequences.
- Compute Circular Convolution for two sequences.
- Find the Fourier transform, frequency response of x(n), and plot its magnitude and phase.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT.
- Implementation of Decimation-in-time / Decimation-in-frequency radix-2 FFT algorithm.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

DESIGN OF FIR AND IIR DIGITAL FILTERS:

FIR: Symmetric and anti-symmetric FIR filters, Design of linear phase FIR Digital Filters using Windows and Frequency Sampling method.

IIR: IIR filter design by Approximation of Derivatives, IIR filter design by impulse invariance, IIR filter design by bilinear transformation, Characteristics of commonly used analog filters (Butter worth and Chebyshev), Frequency transformations, comparison of IIR & FIR filters.

SKILLS:

- ✓ *Identify the frequency response discrete time system.*
- ✓ *Identify the type and order of the filter for any given application.*
- ✓ *Analyze the stability of the designed filter.*
- ✓ *Design FIR/ IIR filter to a real-world problem's application.*

UNIT-2 **8L+8T+8P=24 Hours**

TRANSFORMS AND REALIZATION:

Transforms: Review of Z-transforms, Properties of Z-transform, Inverse Z- transforms, stability and causality.

Realization of Digital Filters: Structures for FIR systems: Direct form structure, Cascade form structures, Structures for IIR systems: Direct form structures, Signal flow graphs and transposed structures, cascade form structures, Parallel form structures.

PRACTICES:

- Implementation of FIR digital filter using windows.
- Implementation of FIR digital filter using frequency sampling method.
- Implementation of IIR digital filter Butterworth/Chebyshev using bilinear / impulse transformation.
- For the system described by difference equation with input and initial conditions
  a. Find the output y(n) using MATLAB.
  b. Find the system transfer function.
  c. Is the system stable?
- Compute Direct form – I, II realization of the given IIR system function.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Summarize the characteristics of signals and systems and Apply to find the response of the system.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Apply Fourier techniques to find the frequency response.	Apply	1	1, 2, 5, 9, 10
3	Analyse discrete-time systems in both time & transform domain and also through pole-zero placement.	Analyse	1, 2	1, 2, 3, 5, 9, 10
4	Inspect the significance of various digital filter structures.	Analyse	1,2	1, 2, 5, 9, 10, 12
5	Design a digital filter using various techniques.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, 2013.
2. A. V. Oppenheim, and R. W. Schaffer, "Discrete Time Signal Processing", Pearson, 3rd edition, 2014.

REFERENCE BOOKS:

1. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.
2. Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", The MIT Press, 2007.
3. B. P. Lathi and Roger Green, "Essentials of Digital Signal Processing", Cambridge University Press, 2014.
4. M. H. Hayes (2007), Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.
5. Steven Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists", Newnes, 2002.
6. Taan S. ElAli, "Discrete Systems and Digital Signal Processing with Matlab", CRC Press, 2nd edition, 2012.
7. Samir I. Abood, "Digital Signal Processing: A Primer with Matlab", CRC Press, 2020.