SIGNALS & SYSTEMS

Faculty: M. Ravi Kumar

No. of lectures: 45

Prerequisite courses: Differentiation, Integration, Differential Equations

Objectives: To prepare the students to understand signal processing, communication and control systems.

OUTLINE OF SYLLABUS:

Module – I (10 hours)

DISCRETE-TIME SIGNALS AND SYSTEMS:

Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation; Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection; Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems; Correlation of Discrete-Time Signals: Crosscorrelation and Autocorrelation Sequences, Properties.

PROPERTIES OF CONTINUOUS-TIME SYSTEMS:

Block Diagram and System Terminology, System Properties: Homogeneity, Time Invariance, Additivity, Linearity and Superposition, Stability, Causality.

Module – II (12 hours)

THE CONTINUOUS-TIME FOURIER SERIES:

Basic Concepts and Development of the Fourier Series, Calculation of the Fourier Series, Properties of the Fourier Series.

THE CONTINUOUS-TIME FOURIER TRANSFORM:

Basic Concepts and Development of the Fourier Transform, Properties of the Continuous-Time Fourier Transform.

Module - III (13 hours)

THE Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS:

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction

Expansion; The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations.

THE DISCRETE FOURIER TRANSFORM: ITS PROPERTIES AND APPLICATIONS:

Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

COURSE DETAILS:

Sl. No.	**Topics**	**No. of Hours**
1	Introduction to signals and systems, Course outline.	1
2	Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation	3
3	Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection	3
4	Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems	3
5	Discrete-Time Systems Described by Difference Equations	2
6	Implementation of Discrete-Time Systems	2
7	Correlation of Discrete-Time Signals: Crosscorrelation and Autocorrelation Sequences, Properties.	2
8	Block Diagram and System Terminology, System Properties: Homogeneity, Time Invariance, Additivity, Linearity and Superposition, Stability, Causality.	3
9	The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform	2
10	Properties of the Z-Transform	4
11	Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System	3
12	Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion	3
13	The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations	2
14	Frequency Domain Sampling: The Discrete Fourier Transform	3
15	Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties	3
16	Basic Concepts and Development of the Fourier Series, Calculation of the Fourier Series, Properties of the Fourier Series.	2
17	Basic Concepts and Development of the Fourier Transform, Properties of the Continuous-Time Fourier Transform.	4

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson. (Selected portions from Chapters 2,3 & 7)

2. Fundamentals of Signals and Systems by M. J. Roberts and G. Sharma, 2nd Edition, TMH. (Selected portions from Chapters 6, 10 & 12/Chapters 4, 8 & 10 from 1st Edition)

Reference Books:

1. Signals and Systems by P. R. Rao, TMH

2. Signals and Systems by A Nagoor Kani, TMH

3. Signals and Systems by Chi-Tsong Chen, Oxford

4. Principles of Signal Processing and Linear Systems by B.P. Lathi, Oxford.

5. Principles of Linear Systems and Signals by B.p. Lathi, Oxford

6. Signals and Systems by Simon Haykin & Barry Van Veen, 2nd Edition, Wiley