Preface

The main objective of this book is to explore the basic concepts of signals and systems in a simple and easy-to-understand manner.

This text on signals and system has been crafted and designed to meet students' requirements. Considering the highly mathematical nature of this subject, more emphasis has been given on the problem-solving methodology. Considerable effort has been made to elucidate mathematical derivations in a step-by-step manner. Exercise problems with varied difficulty levels are given in the text to help students get an intuitive grasp on the subject.

This book with its lucid writing style and germane pedagogical features will prove to be a master text for engineering students and practitioners.

Salient Features

The salient features of this book are

- Separate discussions on continuous time and discrete time signals for thorough understanding of the concepts
- Proof of properties of transforms clearly highlighted by shaded boxes for quick review
- Additional explanations for solutions and proofs provided in separate boxes
- Different types of fonts used for text, proof and solved problems providing better clarity and user-friendliness

Organization

In this book, the concepts of continuous time signals and systems are organized in four chapters. The concepts of discrete time signals and systems are organized in six chapters, and one chapter is devoted to a general discussion on signals and systems. Each chapter provides the foundations and practical implications with a large number of solved numerical examples for better understanding.
The important concepts are summarized at the end of each chapter which help in quick reference. Another significant aspect of this book is MATLAB based computer exercises with complete explanations given in each chapter. This will be of great assistance to both instructors and students.

Chapter 1 deals with a general introduction to various types of signals, systems and their importance in real life. Basic definitions of signals, their mathematical representation, significance of their frequency domain analysis and usage of MATLAB in this course are presented in a brief manner.

Chapter 2 introduces analysis of continuous time signals and systems in depth. It explores various classifications of continuous time signals, systems, and possible mathematical operations such as scaling, folding, time shifting, addition, multiplication, differentiation and integration on them. Then, it discusses block diagrams and signal flow graph representation of continuous time systems, LTI systems characterized by linear differential equations and methods to solve those equations.
Another vital aspect of Chapter 2 is the discussion on graphical convolution operation of continuous-time signals by clearly separating the shift index and the time index. This will aid in clear understanding of the concepts.

Chapter 3 discusses the analysis of continuous time systems using Laplace transform. The rational functions of 's' and their representation in terms of poles and zeros, region of convergence of Laplace transform and its properties are presented in a crisp and easy manner. The stability of the LTI systems and their response via Laplace transforms are dealt with lucidly.

Further, the inverse Laplace transform using partial-fraction method and convolution theorem are discussed. The convolution and deconvolution operations are explained with simple numerical examples. The realization structures for continuous-time systems characterized by differential equations are also presented in this chapter.

Chapter 4 is concerned with Fourier analysis of continuous-time systems which forms the basis for frequency domain analysis. The first half of this chapter is dedicated to Fourier series in both trigonometric and exponential forms, Fourier coefficients of various signals with symmetry, properties of Fourier series and the Gibbs phenomenon.
The second half of the chapter explains the development of Fourier transform from Fourier series, frequency spectrum, various properties of Fourier transform, and Fourier transform of some standard signals. It also covers the computation of frequency responses of LTI systems using Fourier transform explained with examples. The chapter also talks about the relation between Fourier transform and Laplace transform of continuous-time signals.

Chapter 5 deals with the concepts of state space analysis of continuous-time systems. In this chapter, the development of state model, solutions to state equations and response of continuous-time systems to state models are discussed.

Chapter 6 is devoted to concepts of discrete-time signals and systems and is more concerned with the generation, representation, classification, mathematical operations of discrete time signals and systems, block diagrams and signal-flow graph notations.
The chapter also presents the methods of obtaining responses of LTI discrete-time systems and various convolution methods. The deconvolution, correlation techniques and the inverse systems are clearly explained with solved numerical examples. In addition, the concept of sampling and its importance are dealt with briefly.

Chapter 7 explains Z-transform and its application to signals and systems. The concepts are similar to Laplace transform except as applied to discrete-time signals and systems. All the important properties of Z-transform are presented explicitly. Inverse Z-transform and solution of difference equations describing the discrete-time systems are demonstrated with numerical examples. Also given are the systems interconnections and standard system realization using structures.

Chapter 8 is dedicated to discrete-time Fourier series and Fourier transform which forms the basis for frequency domain analysis of discrete-time signals and systems. In the first half of this chapter, the discrete-time Fourier series and the frequency spectrum using discrete-time Fourier series are discussed with relevant examples.
The second half of the chapter details the development of discrete-time Fourier transform from discrete-time Fourier series, frequency spectrum, various properties of Fourier transform, and Fourier transform of some standard discrete-time signals. In addition, the computation of frequency responses of LTI discrete-time systems using Fourier transform are also explained with numerous examples. The relation between Fourier transform and Z-transform of discrete-time signals is also discussed in the chapter.

Chapter 9 extends the understanding of the concepts of Discrete-Time Fourier Transform (DTFT) to DFT (Discrete Fourier Transform) and FFT (Fast Fourier Transform). Development of DFT from DTFT, properties of DFT, relation between DFT and Z-transform, analysis of the LTI systems using DFT and FFT are extensively discussed.

Chapter 10 focuses on structures for realization of discrete-time systems with special attention to IIR and FIR systems.

Chapter 11 presents the concepts of state space analysis of discrete-time systems. In this chapter, the development of state model of discrete-time systems, solutions to state equations and response of discrete-time systems from state models are discussed in an easy manner.

Web Supplements

This book is accompanied by a comprehensive website which can be accessed at http://www.mhhe.com/nagoorkani/signals1e. It has been designed to provide valuable resources for students, instructors and professionals.

- Students can access Interactive Quiz, Objective-Type Questions and Short-Answer-Type Questions on the website.
- Supplementary teaching material for Instructors includes chapterwise PowerPoint slides for effective lecture presentation and an on-request Solution Manual.

Feedback

I have taken care to present the concepts of signals and systems in a user-friendly manner and hope that the teaching and student community will welcome the book. The readers may feel free to convey their criticism and suggestions for further improvement of the book. The feedback is welcome at my email address: kani@vsnl.com

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