Table of contents

- Preface
- Each chapter ends with a Summary and References.
- Each Matlab section ends with Problems.
- B Background
- B.1 Complex Numbers
- B.2 Sinusoids
- B.3 Sketching Signals
- B.4 Cramer's Rule
- B.5 Partial Fraction Expansion
- B.6 Vectors and Matrices
- B.7 Miscellaneous
- Matlab Session B Elementary Operations
- B.M.1 Matlab Overview
- B.M.2 Calculator Operations
- B.M.3 Vector Operations
- B.M.4 Simple Plotting
- B.M.5 Element-by-Element Operations
- B.M.6 Matrix Operations
- B.M.7 Partial Fraction Expansions
- 1 Signals and Systems
- 1.1 Size of a Signal
- 1.2 Some Useful Signal Operations
- 1.3 Classification of Signals
- 1.4 Some Useful Signal Models
- 1.5 Even and Odd Functions
- 1.6 Systems
- 1.7 Classification of Systems
- 1.8 System Model: Input-Output Description
- 1.9 Internal and External Descriptions of a System
- 1.10 Internal Description: The State-Space Description
- Matlab Session 1 Working with Functions
- 1.M.1 Inline Functions
- 1.M.2 Relational Operators and the Unit Step Function
- 1.M.3 Visualizing Operations on the Independent Variable
- 1.M.4 Numerical Integration and Estimating Signal Energy
- 2 Time-Domain Analysis of Continuous-Time Systems
- 2.1 Introduction
- 2.2 System Response to Internal Conditions: The Zero-Input Response
- 2.3 The Unit Impulse Response h(t)
- 2.4 System Response to External Input: Zero-State Response
- 2.5 Classical Solution of Differential Equations
- 2.6 System Stability
- 2.7 Intuitive Insights into System Behavior
- 2.8 Appendix 2.1: Determining the Impulse Response

- Matlab Session 2 M-Files
- 2.M.1 Script M-Files
- 2.M.2 Function M-Files
- 2.M.3 For Loops
- 2.M.4 Graphical Understanding of Convolution
- 3 Time-Domain Analysis of Discrete-Time Systems
- 3.1 Introduction
- 3.2 Useful Signal Operations
- 3.3 Some Useful Discrete-Time Signal Models
- 3.4 Examples of Discrete-Time Systems
- 3.5 Discrete-Time System Equations
- 3.6 System Response to Internal Conditions: The Zero-Input Response
- 3.7 The Unit Impulse Response h[n]
- 3.8 System Response to External Input: The Zero-State Response
- 3.9 Classical Solution of Linear Difference Equations
- 3.10 System Stability: The External (BIBO) Stability Criterion
- 3.11 Intuitive Insights into System Behavior
- 3.12 Appendix 3.1: Impulse Response for a Special Case When aN = 0
- Matlab Session 3 Discrete-Time Signals and Systems
- 3.M.1 Discrete-Time Functions and Stem Plots
- 3.M.2 System Responses Through Filtering
- 3.M.3 A Custom Filter Function
- 3.M.4 Discrete-Time Convolution
- 4 Continuous-Time System Analysis Using the Laplace Transform
- 4.1 The Laplace Transform
- 4.2 Some Properties of the Laplace Transform
- 4.3 Solution of Differential and Integro-Differential Equations
- 4.4 Analysis of Electrical Networks: The Transformed Network
- 4.5 Block Diagrams
- 4.6 System Realization
- 4.7 Application to Feedback and Controls
- 4.8 Frequency-Response of an LTIC System
- 4.9 Bode Plots
- 4.10 Filter Design by Placement of Poles and Zeros of H(s)
- 4.11 The Bilateral Laplace Transform
- Matlab Session 4 Continuous-Time Filters
- 4.M.1 Frequency Response and Polynomial Evaluation
- 4.M.2 Design and Evaluation of a Simple RC Filter
- 4.M.3 A Cascaded RC Filter and Polynomial Expansion
- 4.M.4 Butterworth Filters and the FIND Command
- 4.M.5 Butterworth Filter Realization Using Cascaded Second.Order Sections
- 4.M.6 Chebyshev Filters
- 5 Discrete-Time System Analysis Using the z-Transform
- 5.1 The z-Transform
- 5.2 Some Properties of the z-Transform

- 5.3 z-Transform Solution of Linear Difference equations
- 5.4 System Realization
- 5.5 Frequency Response of Discrete-Time Systems
- 5.6 Frequency Response from Pole-Zero Location
- 5.7 Digital Processing of Analog Signals
- 5.8 Connection Between the Laplace and the z-Transform
- 5.9 The Bilateral z-Transform
- Matlab Session 5 Discrete-Time IIR Filters
- 5.M.1 Frequency Response and Pole-Zero Plots
- 5.M.2 Transformation Basics
- 5.M.3 Transformation by First-Order Backward Difference
- 5.M.4 Bilinear Transformation
- 5.M.5 Bilinear Transformation with Prewarping
- 5.M.6 Example: Butterworth Filter Transformation
- 5.M.7 Problems Finding Polynomial Roots
- 5.M.8 Improved Design Using Cascaded Second-Order Sections
- 6 Continuous-Time Signal Analysis: The Fourier Series
- 6.1 Periodic Signal Representation by Trigonometric Fourier Series
- 6.2 Existence and Convergence of the Fourier Series
- 6.3 Exponential Fourier Series
- 6.4 LTIC System Response to Periodic Inputs
- 6.5 Generalized Fourier Series: Signals as Vectors
- 6.6 Numerical Computation of Dn
- Matlab Session 6 Fourier Series Applications
- 6.M.1 Periodic Functions and the Gibbs Phenomenon
- 6.M.2 Optimization and Phase Spectra
- 7 Continuous-Time Signal Analysis: The Fourier Transform
- 7.1 Aperiodic Signal Representation by Fourier Integral
- 7.2 Transforms of Some Useful Functions
- 7.3 Some Properties of the Fourier Transform
- 7.4 Signal Transmission Through LTIC Systems
- 7.5 Ideal and Practical Filters
- 7.6 Signal Energy
- 7.7 Application to Communications: Amplitude Modulation
- 7.8 Data Truncation: Window Functions
- Matlab Session 7 Fourier Transform Topics
- 7.M.1 The Sinc Function and the Scaling Property
- 7.M.2 Parseval's Theorem and Essential Bandwidth
- 7.M.3 Spectral Sampling
- 7.M.4 Kaiser Window Functions
- 8 Sampling: The Bridge from Continuous to Discrete
- 8.1 The Sampling Theorem
- 8.2 Signal Reconstruction
- 8.3 Analog-to-Digital (A/D) Conversion
- 8.4 Dual of Time-Sampling: The Spectral Sampling

- 8.5 Numerical Computation of the Fourier Transform: The Discrete Fourier Transform (DFT)
- 8.6 The Fast Fourier Transform (FFT)
- Matlab Session 8 The Discrete Fourier Transform
- 8.M.1 Computing the Discrete Fourier Transform
- 8.M.2 Improving the Picture with Zero-Padding
- 8.M.3 Quantization
- 9 Fourier Analysis of Discrete-Time Signals
- 9.1 Discrete-Time Fourier Series (DTFS)
- 9.2 Aperiodic Signal Representation by Fourier Integral
- 9.3 Properties of DTFT
- 9.4 LTI Discrete-Time System Analysis by DTFT
- 9.5 DTFT Connection with the CTFT
- 9.6 Generalization of the DTFT and the z-Transform
- Matlab Session 9 Working with the DTFS and the DTFT
- 9.M.1 Computing the Discrete-Time Fourier Series
- 9.M.2 Measuring Code Performance
- 9.M.3 FIR Filter Design by Frequency Sampling
- 10 State-Space Analysis
- 10.1 Introduction
- 10.2 A Systematic Procedure for Determining State Equations
- 10.3 Solution of State Equations
- 10.4 Linear Transformation of State Vectors
- 10.5 Controllability and Observability
- 10.6 State-Space Analysis of Discrete-Time Systems
- Matlab Session 10 Toolboxes and State-Space Analysis
- 10.M.1 z-Transform Solutions to Discrete-Time State-Space Systems
- 10.M.2 Transfer Functions from State-Space Representations
- 10.M.3 Controllability and Observability of Discrete-Time Systems
- 10.M.4 Matrix Exponentiation and the Matrix Exponential
- Index