

Table of Contents

Preface

Chapter 1 — Introduction

- 1.1 Introduction
- 1.2 Basic Steps to Design a Control System
- 1.3 Mathematical Representation

Chapter 2 — Matrices

- 2.1 Introduction
- 2.2 Definition of Matrix
- 2.3 Square Matrix
- 2.4 Column Matrix or Vector
- 2.5 Row Matrix or Vector
- 2.6 Diagonal Matrix
- 2.7 Identity Matrix
- 2.8 Null Matrix
- 2.9 Symmetric Matrix
- 2.10 Determinant of Matrix
- 2.11 Matrix Algebra
- 2.12 Transpose of a Matrix
- 2.13 Adjoint of a Matrix
- 2.14 Inverse of a Matrix
- 2.15 Rank of a Matrix
- 2.16 Trace of a Matrix
- 2.17 Derivative of a Matrix
- 2.18 Exponential of a Matrix

Chapter 3 — Laplace Transform

- 3.1 Introduction
- 3.2 Definition of Laplace Transform
- 3.3 Laplace Theorems
- 3.4 Laplace Transform Theorems
- 3.5 Important Laplace Transform Pairs
- 3.6 Inverse Laplace Transform
- 3.7 Partial-Fraction Expansion Method
- 3.8 Convolution Integral
- 3.9 Solution of Differential Equations
- 3.10 Conclusion

Chapter 4 — MATLAB Basics

- 4.1 Introduction
- 4.2 MATLAB Environment
- 4.3 MATLAB Features
- 4.4 Vectors
- 4.5 Matrices
- 4.6 Eigenvalues and Eigenvectors
- 4.7 Transfer Functions
- 4.8 Polynomials
- 4.9 Partial Fractions
- 4.10 Symbolic Math Commands

Chapter 5 — Control System: Basic Theory

- 5.1 Introduction
- 5.2 Definition
- 5.3 Classification
- 5.4 General Classification
- 5.5 Elements of a Feedback Control System
- 5.6 Representation of Control Systems
- 5.7 Mason's Gain Formula
- 5.8 Conclusion

Chapter 6 — State-Space Concepts and Analysis of State Equations

- 6.1 Introduction
- 6.2 Basic Terms
- 6.3 Trajectories in State Space
- 6.4 Nonlinearities and Linearisation
- 6.5 State Equation
- 6.6 State Equation: Homogeneous and Non-Homogeneous Parts
- 6.7 Solution of Non-Homogeneous State Equations
- 6.8 Solution of Non-Homogeneous Time-Invariant Matrix Differential Equation
- 6.9 Solution of Homogeneous Time-Invariant Matrix Differential Equation
- 6.10 State-Transition Matrix
- 6.11 Properties of State Transition Matrix
- 6.12 Computation of State Transition Matrix
- 6.13 Laplace Transform Solution of State Equations
- 6.14 Transfer Function Matrix
- 6.15 Representation of State-Equation Solution in Terms of $\Phi(t)$
- 6.16 Characteristic Equation
- 6.17 MATLAB

Chapter 7 — State-Space Modelling

- 7.1 Introduction
- 7.2 State-Variable Diagram
- 7.3 State Models: Signal Flow Graphs
- 7.4 State Models — Various Forms
- 7.5 Similarity Transformations
- 7.6 Other Useful Transformations
- 7.7 Decomposition of Transfer Function
- 7.8 MATLAB

Chapter 8 — Controllability and Observability

- 8.1 Introduction
- 8.2 Controllability and Observability
- 8.3 Definition
- 8.4 Controllability Tests
- 8.5 Rank of a Matrix
- 8.6 Observability Tests
- 8.7 Output Controllability
- 8.8 Pole-Zero Cancellation in Transfer Function
- 8.9 Duality Theorem / Principle / Property
- 8.10 Design
- 8.11 Ackermann's Formula
- 8.12 MATLAB

Summary

References

Index