

Table of Contents

- 1 State-Variable Analysis of Continuous-Time Systems p. 1
- 1.1 Introduction p. 1
- 1.2 Definitions Concerning the State-Space Approach p. 2
- 1.3 Block-Diagram Representation of a General Control System p. 3
- 1.4 State Model of a General Control System p. 3
- 1.5 State Model of a Linear Multi-Input-Multi-Output System p. 6
- 1.6 State Model of a Linear Single-Input-Single-Output System p. 9
- 1.7 Linearization of the State Equation of a General Time-Invariant Control System p. 10
- 1.8 Homogeneous and Nonhomogeneous Linear Time-Invariant Systems p. 12
- 1.9 Solution of State Equations for Linear Time-Invariant Systems p. 13
- 1.10 Solution of State Equations for Linear Time-Varying Systems p. 23
- 1.11 Transfer Matrix from the State Model p. 28
- 1.12 Characteristic Equation, EigenValues, and EigenVectors p. 32
- 1.13 State-Space Representation of Control Systems p. 34
- 1.14 Similarity Transformation p. 57
- 1.15 Concepts of Controllability and Observability p. 75
- Exercises p. 93
- References p. 97
- 2 Analysis of Discrete-Time Systems p. 99
- 2.1 Introduction p. 99
- 2.2 Sampled-Data and Digital Control Systems p. 99
- 2.3 The z-Transform p. 110
- 2.4 The Inverse z-transform p. 121
- 2.5 Solution of Difference-Equations using the z-transform p. 126
- 2.6 The z-Transfer Function (Pulse Transfer Function) p. 128
- 2.7 State-Space Representation of Discrete-Time Systems p. 140
- 2.8 Solution of State-Equations for Linear Time-Invariant Discrete-Time Systems p. 141
- Exercises p. 145
- References p. 147
- 3 Stability Analysis of nonlinear systems p. 149
- 3.1 Introduction p. 149
- 3.2 Autonomous System and Equilibrium State p. 150
- 3.3 Stability Definitions p. 150
- 3.4 Concept of Sign-Definiteness p. 152
- 3.5 Quadratic Form of a Scalar Function p. 154
- 3.6 Definiteness of a Matrix (Sylvester's Theorem) p. 154
- 3.7 Lyapunov's Stability Criterion: (Direct Method of Lyapunov) p. 156
- 3.8 Lyapunov's Direct Method and Linear Time-Invariant System p. 163
- 3.9 Constructing Lyapunov's Function for Nonlinear Systems(Krasovskii's Method) p. 167
- 3.10 Popov's Criterion for Stability of Nonlinear Systems p. 171
- Exercises p. 174
- References p. 176

- 4 Optimal Control p. 177
- 4.1 Introduction p. 177
- 4.2 Performance Indices p. 178
- 4.3 Optimal Control Problems p. 180
- 4.4 Minimization of Performance Index p. 185
- 4.5 Principle of Optimality p. 185
- 4.6 Solutions to Optimal Control Problems p. 189
- Exercises p. 201
- References p. 202
- 5 Adaptive Control p. 205
- 5.1 Introduction p. 205
- 5.2 Essential Components of an Adaptive System p. 206
- 5.3 Adaptive Schemes p. 208
- 5.4 Abuses of Adaptive Control p. 212
- 5.5 Applications p. 213
- Exercises p. 213
- References p. 214
- Appendix A Selected Answers to the exercises p. 215
- Appendix B Laplace and z-Transform Pairs p. 219
- Appendix C About the CD-ROM p. 221
- Index p. 223