- Chapter 1 Introduction p. 1
- 1.1 Mechatronics and Emerging Trends in Engineering p. 1
- 1.2 Basic Foundations p. 7
- 1.2.1 Mechanics p. 8
- 1.2.2 Electromagnetics p. 15
- 1.3 Engineering Computations Using Matlab p. 28
- 1.4 Analysis and Modeling of Dynamic Systems Using Matlab: An Introduction p. 34
- 1.4.1 Continuous-Time Systems p. 34
- 1.4.2 Discrete-Time Systems p. 54
- References p. 64
- Chapter 2 Electromechanical System Dynamics, Energy Conversion, and Electromechanical Analogies p. 65
- 2.1 Mathematical Models and System Dynamics p. 65
- 2.1.1 Newtonian Mechanics p. 65
- 2.1.2 The Lagrange Equations of Motion p. 76
- 2.2 Energy Conversion p. 90
- 2.3 Electromechanical Analogies p. 95
- References p. 111
- Chapter 3 Introduction to Feedback Control of Electromechanical Systems p. 113
- 3.1 Continuous-Time Electromechanical Systems and Analog PID Controllers p. 114
- 3.2 Analog Control of Permanent-Magnet Direct Current Motor p. 119
- 3.3 Electromechanical Systems with Digital PID Controllers p. 127
- 3.4 Control of Permanent-Magnet Direct Current Motor Using Digital Controller p. 137
- References p. 145
- Chapter 4 Introduction to Microelectronic Circuits, Power Electronic Devices, and Power Converters p. 147
- 4.1 Operational Amplifiers p. 147
- 4.2 Circuit Elements p. 156
- 4.2.1 Diodes p. 156
- 4.2.2 Transistors p. 160
- 4.3 Power Amplifiers and Power Converters p. 164
- 4.3.1 Switching Converters p. 165
- 4.3.2 Resonant Converters p. 182
- References p. 187
- Appendix 4.1 Lower Power, Single Supply Operational Amplifiers MC33171, MC33172, and MC33174 p. 188
- Appendix 4.2 JFET Input Operational Amplifiers MC34080 to MC34085 p. 195
- Appendix 4.3 Dual Operational Amplifier and Comparator MC3405 p. 206
- Appendix 4.4 npn Silicon Transistors MJ16010, MJW16010, MJ16012, and MJW16012 p. 212
- Appendix 4.5 High-Speed MOSFET Drivers MC33152 and MC34152 p. 220
- Appendix 4.6 Single IGBT Gate Driver MC33153 p. 228
- Appendix 4.7 Step-Down DC-DC Converter LM2575 p. 239
- Appendix 4.8 High-Speed PWM Controllers MC33025 and MC34025 p. 260
- Appendix 4.9 PWM Control Circuits MC33063A and MC34063A p. 275
- Chapter 5 Direct-Current Machines p. 283

- 5.1 Introduction p. 283
- 5.2 Doubly Excited Transducer and Introduction to Fundamentals of Alternating-Current and Direct-Current Electric Machines p. 287
- 5.2.1 Analysis of Commutator Machines p. 289
- 5.2.2 Analysis of Induction Machines p. 290
- 5.2.3 Analysis of Synchronous Machines p. 291
- 5.3 Separately Excited Direct-Current Machines p. 292
- 5.4 Shunt-Connected Direct-Current Machines p. 304
- 5.5 Series-Connected Direct-Current Machines p. 307
- 5.6 Compound-Connected Direct-Current Electric Machines p. 310
- 5.7 Permanent-Magnet Direct-Current Machines p. 313
- 5.8 Modeling and Analysis of Permanent-Magnet Direct-Current Generators p. 318
- 5.8.1 Modeling and Analysis of Permanent-Magnet Direct-Current Generators Driven by Permanent-Magnet Direct-Current Motors p. 318
- 5.8.2 Modeling and Analysis of Direct-Current Generators with Permanent-Magnet Direct-Current Motors p. 330
- 5.9. Model Development and Analysis of Ward-Leonard Systems with Direct-Current Electric Machines p. 348
- 5.9.1 Ward-Leonard System with Permanent-Magnet Direct-Current Motors and Generators p. 348
- 5.9.2 Ward-Leonard System with Separately Excited Direct-Current Machines p. 356
- References p. 370
- Chapter 6 Induction Machines p. 371
- 6.1 Introduction p. 372
- 6.2 Voltage, Flux Linkages, and Torque Equations for Two-Phase Induction Machines: Dynamics in the Machine Variables p. 373
- 6.3 Mathematical Models of Two-Phase Induction Machines in the Arbitrary, Stationary, Rotor, and Synchronous Reference Frames p. 407
- 6.3.1 Development of the Mathematical Model of Two-Phase Induction Motors in the Stationary Reference Frame p. 437
- 6.3.2 Development of the Mathematical Model of Two-Phase Induction Motors in the Rotor Reference Frame p. 453
- 6.3.3 Development of the Mathematical Model of Two-Phase Induction Motors in the Synchronous Reference Frame p. 480
- 6.4. Voltage, Flux Linkages, and Torque Equations for Three-Phase Induction Machines: Dynamics in the Machine Variables p. 497
- 6.5. Mathematical Models of Three-Phase Induction Machines in the Arbitrary, Stationary, Rotor, and Synchronous Reference Frames p. 508
- 6.5.1. Development of the Mathematical Model of Three-Phase Induction Motors in the Stationary Reference Frame p. 526
- 6.5.2. Development of the Mathematical Model of Three-Phase Induction Motors in the Rotor Reference Frame p. 530
- 6.5.3. Development of the Mathematical Model of Three-Phase Induction Motors in the Synchronous Reference Frame p. 536
- 6.6. Power Converters and Control of Induction Machines p. 546
- References p. 557

- Chapter 7 Synchronous Machines p. 559
- 7.1 Introduction p. 559
- 7.2 Synchronous Reluctance Motors p. 560
- 7.2.1 Mathematical Models of Synchronous Reluctance Motors in the Machine Variables p. 564
- 7.2.2 Mathematical Models of Synchronous Reluctance Motors in the Rotor and Synchronous Reference Frames p. 579
- 7.3 Permanent-Magnet Synchronous Machines p. 589
- 7.3.1 Dynamics of Permanent-Magnet Synchronous Machines in the Machine Variables p. 590
- 7.3.2 Development of Mathematical Models of Permanent-Magnet Synchronous Machines in the Arbitrary, Rotor, and Synchronous Reference Frames p. 616
- 7.4 Conventional Three-Phase Synchronous Machines: Dynamics in the Machine Variables, and in the Rotor and Synchronous Reference Frames p. 637
- 7.4.1 Dynamics of Synchronous Machines in the Machine Variables p. 637
- 7.4.2 Mathematical Models of Synchronous Machines in the Rotor and Synchronous Reference Frames p. 660
- 7.5 Stepper Motors p. 666
- 7.5.1 Mathematical Model of Permanent-Magnet Stepper Motors in the Machine Variables p. 674
- 7.5.2 Mathematical Models of Permanent-Magnet Stepper Motors in the Rotor and Synchronous Reference Frames p. 680
- References p. 692
- Chapter 8 Mechatronic Systems p. 693
- 8.1 Introduction p. 693
- 8.2 Mechatronic Systems with Permanent-Magnet Direct-Current Motors p. 694
- 8.3 Analysis and Design of an Electric Drive with Experimental Verification p. 699
- 8.4 Mechatronic Systems with Direct-Current Motors p. 705
- 8.5 Mechatronic Systems with Induction Motors p. 711
- 8.6 Mechatronic Systems with Permanent-Magnet Synchronous Motors p. 712
- 8.7 Digital Control of Mechatronic Systems p. 720
- References p. 728
- Appendix 8.1 Direct-Current Servo Motor Driver p. 729
- Appendix 8.2 Stepper Motor Driver p. 743
- Appendix 8.3 Angular Velocity Estimator p. 751
- Appendix 8.4 Permanent-Magnet Synchronous Motor Driver p. 756
- Index p. 779