# CONTENTS

FOREWORD  xiii  
CONTRIBUTORS  xv  

## 1  
**BIOMEDICAL ENGINEERING:**  
A HISTORICAL PERSPECTIVE  1  

1.1 Evolution of the Modern Health Care System  2  
1.2 The Modern Health Care System  8  
1.3 What Is Biomedical Engineering?  17  
1.4 Roles Played by Biomedical Engineers  20  
1.5 Professional Status of Biomedical Engineering  23  
1.6 Professional Societies  25  
Exercises  27  
Suggested Reading  28  

## 2  
**ANATOMY AND PHYSIOLOGY**  29  

2.1 Introduction  30  
2.2 Cellular Organization  32  
2.3 Tissues  46
## CONTENTS

2.4  Major Organ Systems  46  
2.5  Homeostasis  72  
Exercises  74  
Suggested Reading  76  

3  BIOELECTRIC PHENOMENA  79  
3.1  Introduction  80  
3.2  History  81  
3.3  Neurons  89  
3.4  Basic Biophysics Tools and Relationships  95  
3.5  Equivalent Circuit Model for the Cell Membrane  105  
3.6  Hodgkin-Huxley Model of the Action Potential  115  
Exercises  131  
Suggested Reading  137  

4  BIOMEDICAL SENSORS  139  
4.1  Introduction  140  
4.2  Biopotential Measurements  142  
4.3  Physical Measurements  147  
4.4  Blood Gases and pH Sensors  161  
4.5  Bioanalytical Sensors  169  
4.6  Optical Biosensors  171  
Exercises  176  
Suggested Reading  177  

5  BIOINSTRUMENTATION  179  
5.1  Introduction  180  
5.2  Basic Instrumentation System  184  
5.3  Analog Circuits  186  
5.4  Signal Conditioning  193  
5.5  Instrumentation Design  210  
5.6  Computer-Based Instrumentation Systems  225  
5.7  Summary  227  
Exercises  228  
Suggested Reading  231  

6  BIOSIGNAL PROCESSING  233  
6.1  Introduction  234  
6.2  Physiological Origins of Biosignals  234
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3 Characteristics of Biosignals</td>
<td>238</td>
</tr>
<tr>
<td>6.4 Signal Acquisition</td>
<td>240</td>
</tr>
<tr>
<td>6.5 Frequency Domain Representation of Biosignals</td>
<td>245</td>
</tr>
<tr>
<td>6.6 The Z Transform</td>
<td>251</td>
</tr>
<tr>
<td>6.7 Digital Filters</td>
<td>253</td>
</tr>
<tr>
<td>6.8 Signal Averaging</td>
<td>256</td>
</tr>
<tr>
<td>6.9 Wavelet Transform and Short-Time Fourier Transform</td>
<td>260</td>
</tr>
<tr>
<td>6.10 Artificial Intelligence Techniques</td>
<td>269</td>
</tr>
<tr>
<td>Exercises</td>
<td>276</td>
</tr>
<tr>
<td>Suggested Reading</td>
<td>277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 PHYSIOLOGICAL MODELING</td>
<td>279</td>
</tr>
<tr>
<td>7.1 Introduction</td>
<td>280</td>
</tr>
<tr>
<td>7.2 An Overview of the Fast Eye Movement System</td>
<td>284</td>
</tr>
<tr>
<td>7.3 Westheimer’s Saccadic Eye Movement Model</td>
<td>290</td>
</tr>
<tr>
<td>7.4 The Saccade Controller</td>
<td>296</td>
</tr>
<tr>
<td>7.5 Development of an Oculomotor Muscle Model</td>
<td>300</td>
</tr>
<tr>
<td>7.6 A Linear Muscle Model</td>
<td>312</td>
</tr>
<tr>
<td>7.7 A Linear Homeomorphic Saccadic Eye Movement Model</td>
<td>318</td>
</tr>
<tr>
<td>7.8 A Truer Linear Homeomorphic Saccadic Eye Movement Model</td>
<td>324</td>
</tr>
<tr>
<td>7.9 Saccade Pathways</td>
<td>334</td>
</tr>
<tr>
<td>7.10 System Identification</td>
<td>343</td>
</tr>
<tr>
<td>Exercises</td>
<td>359</td>
</tr>
<tr>
<td>Suggested Reading</td>
<td>367</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 COMPARTMENTAL ANALYSIS</td>
<td>369</td>
</tr>
<tr>
<td>8.1 Introduction</td>
<td>370</td>
</tr>
<tr>
<td>8.2 Model Postulates</td>
<td>371</td>
</tr>
<tr>
<td>8.3 Compartmental Structure</td>
<td>372</td>
</tr>
<tr>
<td>8.4 Modified Compartmental Analysis</td>
<td>396</td>
</tr>
<tr>
<td>8.5 Convective Transport between Physiologic Compartments</td>
<td>401</td>
</tr>
<tr>
<td>Exercises</td>
<td>406</td>
</tr>
<tr>
<td>Suggested Reading</td>
<td>409</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 BIOMECHANICS</td>
<td>411</td>
</tr>
<tr>
<td>9.1 Introduction</td>
<td>412</td>
</tr>
<tr>
<td>9.2 Basic Mechanics</td>
<td>414</td>
</tr>
<tr>
<td>9.3 Mechanics of Materials</td>
<td>433</td>
</tr>
<tr>
<td>9.4 Viscoelastic Properties</td>
<td>440</td>
</tr>
</tbody>
</table>
10  CARdiovascular Mechanics  467

10.1  Introduction  468
10.2  Definition of a Fluid and Basic Principles of Biofluid Mechanics  468
10.3  Constitutive Modeling of Physiologic Fluids: Blood  472
10.4  Generation of Flow in the Cardiovascular System: The Human Heart (Cardiology) and the Cardiac Cycle  490
10.5  Fluid Dynamic Field Equations: Conservation of Mass, Energy, and Momentum  500
10.6  Hemodynamics in Vascular Channels: Arterial (time Dependent) And Venous (Steady)  508
10.7  General Aspects of Control of Cardiovascular Function  528
Exercises  530
Suggested Reading  535

11  BIOMATERIALS  537

11.1  Introduction  538
11.2  Mechanical Properties and Mechanical Testing  539
11.3  General Classification of Materials Used in Medical Devices  544
11.4  Degradation of Materials  554
11.5  Biological Effects  559
11.6  Impact of Degradation of Materials on the Biological System  568
11.7  Biocompatibility Testing  569
11.8  Biomaterials and Device Design Criteria  571
Exercises  575
Suggested Reading  578

12  TISSUE ENGINEERING  579

12.1  Cellular Therapies  581
12.2  Tissue Dynamics  589
12.3  Stem Cells  607
12.4  The Cellular Fate Processes  612
12.5  Cellular Communications  622
12.6  The Tissue Microenvironment  628
12.7  Scaling Up  639
12.8  Delivering Cell Therapies in a Clinical Setting  644
CONTENTS

12.9 Conclusions 648
12.10 Glossary 648
Exercises 650
Suggested Reading 654

13 BIOTECHNOLOGY 657

13.1 Introduction 658
13.2 Basic Techniques 668
13.3 Other Core Technologies 679
13.4 Medical Applications 684
Exercises 694
Suggested Reading 696

14 RADIATION IMAGING 697

14.1 Introduction 698
14.2 Emission Imaging Systems 699
14.3 Instrumentation and Imaging Devices 716
14.4 Radiographic Imaging Systems 721
Exercises 742
Suggested Reading 743

15 ULTRASOUND 745

15.1 Introduction 746
15.2 Fundamentals of Acoustic Propagation 747
15.3 Diagnostic Ultrasonic Imaging 757
15.4 New Developments 771
15.5 Biological Effects of Ultrasound 780
15.6 Therapeutic Ultrasound 781
Exercises 781
Suggested Reading 782

16 NUCLEAR MAGNETIC RESONANCE AND MAGNETIC RESONANCE IMAGING 783

16.1 Introduction 784
16.2 Nuclear Magnetism 787
16.3 NMR 793
16.4 MRI 805
16.5 Instrumentation for MRI 828
Exercises 839
Suggested Reading 841
17 BIOMEDICAL OPTICS AND LASERS 843

17.1 Introduction 844
17.2 Essential Optical Principles 845
17.3 Fundamentals of Light Propagation in Biological Tissue 850
17.4 Physical Interaction of Light and Physical Sensing 862
17.5 Biochemical Measurement Techniques Using Light 870
17.6 Fundamentals of Photothermal Therapeutic Effects of Lasers 878
17.7 Fiber Optics and Waveguides in Medicine 888
17.8 biomedical Optical Imaging 895
Exercises 900
Suggested Reading 903

18 REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY 905

18.1 Introduction 906
18.2 The Human Component 912
18.3 Principles of Assistive Technology Assessment 918
18.4 Principles of Rehabilitation Engineering 921
18.5 Practice of Rehabilitation Engineering and Assistive Technology 932
Exercises 936
Suggested Reading 941

19 CLINICAL ENGINEERING AND ELECTRICAL SAFETY 943

19.1 Introduction 944
19.2 A Historical Perspective 945
19.3 The Role of the Clinical Engineer 947
19.4 Safety in the Clinical Environment 952
19.5 Electrical Safety 954
19.6 Electrical Safety Programs 967
19.7 The Future of Clinical Engineering 969
19.8 Preparation for Clinical Engineers 972
Exercises 973
Suggested Reading 975

20 MORAL AND ETHICAL ISSUES 977

20.1 Introduction 978
20.2 Morality and Ethics: A Definition of Terms 979
20.3 Two Moral Norms: Beneficence and Nonmaleficence 984
20.4 Redefining Death  985
20.5 The Terminally Ill Patient and Euthanasia  989
20.6 Taking Control  993
20.7 Human Experimentation  993
20.8 Definition and Purpose of Experimentation  994
20.9 Informed Consent  995
20.10 Regulation of Medical Device Innovation  1000
20.11 Ethical Issues in Feasibility Studies  1001
20.12 Ethical Issues in Emergency Use  1003
20.13 Ethical Issues in Treatment Use  1004
20.14 The Safe Medical Devices Act of 1990  1005
Exercises  1006
Suggested Reading  1007

INDEX  1009
The purpose of this textbook is to serve as an introduction to and overview of the field of biomedical engineering. During the past 50 years, as the discipline of biomedical engineering has evolved, it has become clear that it is a diverse, seemingly all-encompassing field that includes such areas as biomechanics, biomaterials, bioinstrumentation, medical imaging, rehabilitation engineering, biosensors, biotechnology, and tissue engineering. Although it is not possible to cover all the biomedical engineering domains in this textbook, we have made an effort to focus on most of the major fields of activity in which biomedical engineers are engaged.

The text is written primarily for engineering students who have completed differential equations and basic courses in statics, dynamics, and linear circuits. Students in the biological sciences, including those in the fields of medicine and nursing, can also read and understand this material if they have the appropriate mathematical background.

Although we do attempt to be rigorous with our discussions and proofs, our ultimate aim is to help students grasp the nature of biomedical engineering. Therefore, we have compromised when necessary and have occasionally used less rigorous mathematics in order to make it more understandable. A liberal use of illustrative examples amplifies concepts and develops problem-solving skills. Throughout the text MATLAB (a matrix equation solver) and SIMULINK (an extension to MATLAB for simulating dynamic systems) are used as computer tools to assist with problem solving.

Chapters are written to provide some historical perspective of the major developments in a specific biomedical engineering domain as well as the fundamental principles that underlie
biomedical engineering design, analysis, and modeling procedures in that domain. In addition, examples of some of the problems encountered, as well as the techniques used to solve them, are provided. Selected problems, ranging from simple to difficult, are presented at the end of each chapter in the same general order as covered in the text.

The material in this textbook has been designed for a one-semester, two-semester, or three-quarter sequence depending on the needs and interests of the instructor. Chapter 1 provides necessary background to understand the history and appreciate the field of biomedical engineering. Then the text divides naturally into two parts, physiological systems and modeling (Chapters 2-10) and technology (Chapters 11-19). Serving as a capstone, Chapter 20 addresses the moral and ethical issues associated with the field of biomedical engineering.

John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino

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