

Book Review

Basic Transport Phenomena in Biomedical Engineering, 2nd Edition, by Ronald L. Fournier, Taylor & Francis, New York, 2006

WILLIAM J. FEDERSPIEL

In the words of the author, the second edition of this text "brings together fundamental engineering and life science principles to provide a focused coverage of key transport concepts in biomedical engineering." The book is focused toward the beginning student of biomedical engineering as well as its already-established engineers and scientists. The second edition has been substantially augmented and reorganized over the first edition.

The new text starts with an introductory chapter covering units, dimensions, and several basic approaches and principles applied to solving biomedical transport problems. Before delving into transport processes, the revised text also includes, as Chapter 2, a useful summary on the thermodynamic principles of chemical systems. This chapter will be especially useful for students of biomedical engineering, who sometimes begin the study of transport processes without having had sufficient background in principles of chemical equilibrium. After all, a "transport process" describes a system disrupted from equilibrium that is attempting to regain equilibrium. More practically, the conditions that apply at the boundary of biomedical transport systems stem from various principles of chemical equilibrium at interfaces between various subcellular, cellular, tissue, or organ components (or "compartments").

The remaining chapters in the book appeared in the first edition but have been reorganized, augmented, and reordered. As in other texts on biomedical transport phenomena, momentum transport is addressed before mass transport. Chapter 4 covers the flow dynamics of blood flow with emphasis given to paradigmatic relationships such as the Hagen-Poiseuille equation, as well as the non-Newtonian characteristics of blood rheology and blood rheological models. The chapter also provides coverage and analysis relative to the "particulate effects" of blood flow in the microcirculation, the Fahraeus and Fahraeus-Lindqvist effects describing hematocrit and viscosity reductions in microvessels. Chapters 5 and 6 cover solute and oxygen transport in blood and tissue as well as transcappillary exchange. The breadth of coverage in these chapters is extensive,

with many important paradigms covered, including convective mass transport, capillary filtration, membrane transport, transcapillary solute exchange, oxygen carriage in blood, oxygen transport within tissue (Krogh model), and characteristics of artificial blood.

A strong point of the original text and revised text is coverage of several areas of interest in applied biomedical transport phenomena, which will garner significant interest from beginning students in biomedical engineering. Chapters 7 through 10 cover pharmacokinetics, extracorporeal medical devices, tissue engineering, and biohybrid artificial organs. These are some of the more interesting applications in the biomedical area for implementing transport design principles. The presentation of extracorporeal devices focuses mainly on membrane-based devices such as hemodialyzers and blood oxygenators. The tissue engineering chapter focuses mainly on general principles related to extracellular matrix, cellular receptors, and transport within polymeric matrices. The coverage of biohybrid artificial organs reviews basic principles of immunology and immunological isolation and describes encapsulated cellular systems such as the artificial pancreas. Recent advances in the biohybrid liver and kidney systems are also briefly described. Consistent with the philosophy put forward for this book, the text does not pursue a comprehensive review of contemporary developments in all these areas but instead intends to teach and illustrate principles and applications of biomedical transport phenomena within the context of important technologies currently in clinical use or close to clinical reality.

The suitability of this book as a text for an undergraduate or graduate course in biomedical transport phenomena will largely depend on the style of the instructor. This is not necessarily a textbook that derives important relationships from first principles, nor does it follow a Bird, Stewart, and Lightfoot approach to the development of transport principles. Important concepts in biomedical transport phenomena are introduced, but the pace may seem too rapid for a beginning engineering student. However, the student or practitioner who has already been exposed to some of the engineering principles covered in this text will appreciate the efficiency and breadth with which biomedical applications of classic transport principles are presented. Transport or mechanics faculty working in the bioengineering area will find this book an excellent addition to their bookshelves.

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Basic Transport Phenomena in Biomedical Engineering, 2nd Edition Ronald L. Fournier, 2006-07-07 This text combines the basic principles and theories of transport in biological systems with fundamental bioengineering. It contains real world applications in drug delivery systems, tissue engineering, and artificial organs. Considerable significance is placed on developing a quantitative understanding of the underlying physical, chemical, and biological phenomena. Therefore, many mathematical methods are developed using compartmental approaches. The book is replete with examples and problems.

Basic Transport Phenomena in Biomedical Engineering, Third Edition Ronald L. Fournier, 2011-08-26 Encompassing a variety of engineering disciplines and life sciences, the very scope and breadth of biomedical engineering presents challenges to creating a concise entry level text that effectively introduces basic concepts without getting overly specialized in subject matter or rarified in language. **Basic Transport Phenomena in Biomedical Engineering Third Edition** meets and overcomes these challenges to provide the beginning student with the foundational tools and the confidence they need to apply these techniques to problems of ever greater complexity. Bringing together fundamental engineering and life science principles, this highly accessible text provides a focused coverage of key momentum and mass transport concepts in biomedical engineering. It offers a basic review of units and dimensions, material balances, and problem solving tips, and then emphasizes those chemical and physical transport processes that have applications in the development of artificial and bioartificial organs, controlled drug delivery systems, and tissue engineering. The book also includes a discussion of thermodynamic concepts and covers topics such as body fluids, osmosis, and membrane filtration, physical and flow properties of blood, solute and oxygen transport, and pharmacokinetic analysis. It concludes with the application of these principles to extracorporeal devices, as well as tissue engineering and bioartificial organs. Designed for the beginning student, **Basic Transport Phenomena in Biomedical Engineering Third Edition** provides a quantitative understanding of the underlying physical, chemical, and biological phenomena involved. It offers mathematical models using the shell balance or compartmental approaches, along with numerous examples and end of chapter problems based on these mathematical models, and in many cases, these models are compared with actual experimental data. Encouraging students to work examples with the mathematical software package of their choice, this text provides them the opportunity to explore various aspects of the solution on their own, or apply these techniques as starting points for the solution to their own problems. **Basic Transport Phenomena In Biomedical Engineering** Ronald L. Fournier, 1998-08-01 This text combines the basic principles and theories of transport in biological systems with fundamental bioengineering. It contains real world applications in drug delivery systems, tissue engineering, and artificial organs. Considerable significance is placed on developing a quantitative understanding of the underlying physical, chemical, and biological phenomena. Therefore, many mathematical methods are developed using compartmental approaches. The book is replete with examples and problems. Principles of Biomedical

Engineering, Second Edition Sundararajan Madihally, 2019-12-31 This updated edition of an Artech House classic introduces readers to the importance of engineering in medicine Bioelectrical phenomena principles of mass and momentum transport to the analysis of physiological systems the importance of mechanical analysis in biological tissues organs and biomaterial selection are discussed in detail Readers learn about the concepts of using living cells in various therapeutics and diagnostics compartmental modeling and biomedical instrumentation The book explores fluid mechanics strength of materials statics and dynamics basic thermodynamics electrical circuits and material science A significant number of numerical problems have been generated using data from recent literature and are given as examples as well as exercise problems These problems provide an opportunity for comprehensive understanding of the basic concepts cutting edge technologies and emerging challenges Describing the role of engineering in medicine today this comprehensive volume covers a wide range of the most important topics in this burgeoning field Moreover you find a thorough treatment of the concept of using living cells in various therapeutics and diagnostics Structured as a complete text for students with some engineering background the book also makes a valuable reference for professionals new to the bioengineering field This authoritative textbook features numerous exercises and problems in each chapter to help ensure a solid understanding of the material

Basic Transport Phenomena in Biomedical Engineering Ronald L. Fournier, 2017-08-07 This will be a substantial revision of a good selling text for upper division first graduate courses in biomedical transport phenomena offered in many departments of biomedical and chemical engineering Each chapter will be updated accordingly with new problems and examples incorporated where appropriate A particular emphasis will be on new information related to tissue engineering and organ regeneration A key new feature will be the inclusion of complete solutions within the body of the text rather than in a separate solutions manual Also Matlab will be incorporated for the first time with this Fourth Edition

Basic Transport Phenomena in Biomedical Engineering Ronald L. Fournier, 1999

Solution's Manual - Basic Transport Phenomena in Biomedical Engineering Taylor & Francis Group, 2012-01-15

Transport Phenomena Larry A. Glasgow, 2010-12-01 Enables readers to apply transport phenomena principles to solve advanced problems in all areas of engineering and science This book helps readers elevate their understanding of and their ability to apply transport phenomena by introducing a broad range of advanced topics as well as analytical and numerical solution techniques Readers gain the ability to solve complex problems generally not addressed in undergraduate level courses including nonlinear multidimensional transport and transient molecular and convective transport scenarios Avoiding rote memorization the author emphasizes a dual approach to learning in which physical understanding and problem solving capability are developed simultaneously Moreover the author builds both readers interest and knowledge by Demonstrating that transport phenomena are pervasive affecting every aspect of life Offering historical perspectives to enhance readers understanding of current theory and methods Providing numerous examples drawn from a broad range of fields in the physical and life sciences and engineering Contextualizing problems in

scenarios so that their rationale and significance are clear This text generally avoids the use of commercial software for problem solutions helping readers cultivate a deeper understanding of how solutions are developed References throughout the text promote further study and encourage the student to contemplate additional topics in transport phenomena Transport Phenomena is written for advanced undergraduates and graduate students in chemical and mechanical engineering Upon mastering the principles and techniques presented in this text all readers will be better able to critically evaluate a broad range of physical phenomena processes and systems across many disciplines *Transport Phenomena in Biological Systems* George A. Truskey, Fan Yuan, David F. Katz, 2009 For one semester advanced undergraduate graduate courses in Biotransport Engineering Presenting engineering fundamentals and biological applications in a unified way this text provides students with the skills necessary to develop and critically analyze models of biological transport and reaction processes It covers topics in fluid mechanics mass transport and biochemical interactions with engineering concepts motivated by specific biological problems Molecular, Cellular, and Tissue Engineering Joseph D. Bronzino, Donald R. Peterson, 2018-10-08 Known as the bible of biomedical engineering The Biomedical Engineering Handbook Fourth Edition sets the standard against which all other references of this nature are measured As such it has served as a major resource for both skilled professionals and novices to biomedical engineering Molecular Cellular and Tissue Engineering the fourth volume of the handbook presents material from respected scientists with diverse backgrounds in molecular biology transport phenomena physiological modeling tissue engineering stem cells drug delivery systems artificial organs and personalized medicine More than three dozen specific topics are examined including DNA vaccines biomimetic systems cardiovascular dynamics biomaterial scaffolds cell mechanobiology synthetic biomaterials pluripotent stem cells hematopoietic stem cells mesenchymal stem cells nanobiomaterials for tissue engineering biomedical imaging of engineered tissues gene therapy noninvasive targeted protein and peptide drug delivery cardiac valve prostheses blood substitutes artificial skin molecular diagnostics in personalized medicine and bioethics **Cumulated Index to the Books**, 1999 **Tissue Engineering**, 1999 **Match**, 2009 American Book Publishing Record, 2005 **Control and Regulation of Transport Phenomena in the Cardiac System, Volume 1123** Samuel Sideman, Rafael Beyar, Amir Landesberg, 2008-04-14 Leading researchers in the life sciences and engineers involved in research of transport phenomena in biological systems have contributed chapters that identify analyze and modify the control and regulation mechanisms of transport phenomena in biological systems with particular emphasis on the cardiac system Included in the contributions to this volume are the following topics signaling mechanisms and transport phenomena blood tissue exchange and inter tissue transport cellular membrane transport and endocytosis of ions and metabolites intracellular transport energetics and molecular motors system biology uni and multi scale transport models and hierarchical analysis and clinical considerations cardiac protection metabolic and pharmaceutical augmentation and interferences NOTE Annals volumes are available for sale as individual

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