

Transport Phenomena In Biomedical Engineering Artificial Organ Design And Development And Tissue Engineering

Under the direction of John Enderle, Susan Blanchard and Joe Bronzino, leaders in the field have contributed chapters on the most relevant subjects for biomedical engineering students. These chapters coincide with courses offered in all biomedical engineering programs so that it can be used at different levels for a variety of courses of this evolving field. Introduction to Biomedical Engineering, Second Edition provides a historical perspective of the major developments in the biomedical field. Also contained within are the fundamental principles underlying biomedical engineering design, analysis, and modeling procedures. The numerous examples, drill problems and exercises are used to reinforce concepts and develop problem-solving skills making this book an invaluable tool for all biomedical students and engineers. New to this edition: Computational Biology, Medical Imaging, Genomics and Bioinformatics. * 60% update from first edition to new edition. * New chapters on Computational Biology, Medical Imaging, Genomics, and Bioinformatics * Companion site: http://intro-bme-book.bme.uconn.edu * MATLAB and SIMULINK software used throughout to model and simulate dynamic systems * Numerous self-study homework problems and thorough cross-referencing for easy use

Design, analysis and simulation of tissue constructs is an integral part of the ever-evolving field of biomedical engineering. The study of reaction kinetics, particularly when coupled with complex physical phenomena such as the transport of heat, mass and momentum, is required to determine or predict performance of biologically-based systems whether for research or clinical implementation. Transport Phenomena in Biomedical Engineering: Principles and Practices explores the concepts of transport phenomena alongside chemical reaction kinetics and thermodynamics to introduce the field of reaction engineering as it applies to physiologic systems in health and disease. It emphasizes the role played by these fundamental physical processes. The book first examines elementary concepts such as control volume selection and flow systems. It provides a comprehensive treatment with an overview of major research topics related to transport phenomena pertaining to biomedical engineering. Although each chapter is self-contained, they all bring forth and reinforce similar concepts through applications and discussions. With contributions from world-class experts, the book unmarks the fundamental phenomenological events in engineering devices and explores how to use them to meet the objectives of specific applications. It includes coverage of applications to drug delivery and cell- and tissue-based therapies. This book introduces students to the basic physical principles to analyze fluid flow in micro and nano-size devices. This is the first book that unifies the thermal sciences with electrostatics and electrokinetics and colloid science; electrochemistry; and molecular biology. The author discusses key concepts and principles, such as the essentials of viscous flows, an introduction to electrochemistry, heat and mass transfer phenomena, elements of molecular and cell biology, and much more. This textbook presents state-of-the-art analytical and computational approaches to problems in all of these areas, especially electrokinetic flows, and gives examples of the use of these disciplines to design devices used for rapid molecular analysis, biochemical sensing, drug delivery, DNA analysis, the design of an artificial kidney, and other transport phenomena. This textbook includes exercise problems, modern examples of the applications of these sciences, and a solutions manual for qualified instructors.

An important resource that puts the focus on the chemical engineering aspects of biomedical engineering In the past 50 years remarkable achievements have been advanced in the fields of biomedical and chemical engineering. With contributions from leading chemical engineers, Biomedical Engineering Challenges reviews the recent research and discovery that sits at the interface of engineering and biology. The authors explore the principles and practices that are applied to the ever-expanding array of such new areas as gene-therapy delivery, biosensor design, and the development of improved therapeutic compounds, imaging agents, and drug delivery vehicles. Filled with illustrative case studies, this important resource examines such important work as methods of growing human cells and tissues outside the body in order to repair or replace damaged tissues. In addition, the text covers a range of topics including the challenges faced with developing artificial lungs, kidneys, and livers; advances in 3D cell culture systems; and chemical reaction methodologies for biomedical imaging analysis. This vital resource: Covers interdisciplinary research at the interface between chemical engineering, biology, and chemistry Provides a series of valuable case studies describing current themes in biomedical engineering Explores chemical engineering principles such as mass transfer, bioreactor technologies as applied to problems such as cell culture, tissue engineering, and biomedical imaging Written from the point of view of chemical engineers, this authoritative guide offers a broad-ranging but concise overview of research at the interface of chemical engineering and biology.

Analysis, Modeling, and Computations

Basic Transport Phenomena in Biomedical Engineering

An Introduction to Fluid Mechanics, Macrocruculation, and Microcruculation

Porous Media

Principles and Models of Biological Transport

This advanced text presents a unique approach to studying transport phenomena. Bringing together concepts from both chemical engineering and physics, it makes extensive use of nonequilibrium thermodynamics, discusses kinetic theory, and sets out the tools needed to describe the physics of interfaces and boundaries. More traditional topics such as diffusive and convective transport of momentum, energy and mass are also covered. This is an ideal text for advanced courses in transport phenomena, and for researchers looking to expand their knowledge of the subject. The book also includes:
· Novel applications such as complex fluids, transport at interfaces and biological systems,
· Approximately 250 exercises with solutions (included separately) designed to enhance understanding and reinforce key concepts,
· End-of-chapter summaries.

Heat Transfer and Fluid Flow in Biological Processes covers emerging areas in fluid flow and heat transfer relevant to biosystems and medical technology. This book uses an interdisciplinary approach to provide a comprehensive perspective on biofluid mechanics and heat transfer advances and includes reviews of the most recent methods in modeling of flows in biological media, such as CFD. Written by internationally recognized researchers in the field, each chapter provides a strong introductory section that is useful to both readers currently in the field and readers interested in learning more about these areas. Heat Transfer and Fluid Flow in Biological Processes is an indispensable reference for professors, graduate students, professionals, and clinical researchers in the fields of biology, biomedical engineering, chemistry and medicine working on applications of fluid flow, heat transfer, and transport phenomena in biomedical technology. Provides a wide range of biological and clinical applications of fluid flow and heat transfer in biomedical technology Covers topics such as electrokinetic transport, electroporation of cells and tissue dialysis, inert solute transport (insulin), thermal ablation of cancerous tissue, respiratory therapies, and associated medical technologies Reviews the most recent advances in modeling techniques Both broad and deep in coverage, Rubenstein shows that fluid mechanics principles can be applied not only to blood circulation, but also to air flow through the lungs, joint lubrication, intraocular fluid movement and renal transport. Each section initiates discussion with governing equations, derives the state equations and then shows examples of their usage. Clinical applications, extensive worked examples, and numerous end of chapter problems clearly show the applications of fluid mechanics to biomedical engineering situations. A section on experimental techniques provides a springboard for future research efforts in the subject area. Uses language and math that is appropriate and conducive for undergraduate learning, containing many worked examples and end of chapter problems All engineering concepts and equations are developed within a biological context Covers topics in the traditional biofluids curriculum, as well as addressing other systems in the body that can be described by biofluid mechanics principles, such as air flow through the lungs, joint lubrication, intraocular fluid movement, and renal transport Clinical applications are discussed throughout the book, providing practical applications for the concepts discussed.

This is 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.

Computational Transport Phenomena

A Chemical Engineering Insight

Transport Phenomena in Multiphase Flows

Transport Phenomena Fundamentals

Biological and Bioenvironmental Heat and Mass Transport

Transport Phenomena in Biomedical Engineering represents important life-sustaining elements in all humans. These include mass transfer processes, including gas exchange in the lungs, transport across capillaries and alveoli, transport across the kidneys, and transport across cell membranes. These mass transfer processes affect how oxygen and carbon dioxide are exchanged in your bloodstream, how metabolic waste products are removed from your blood, how nutrients are transported to tissues, and how all cells function throughout the body. A discussion of kidney dialysis and gas exchange mechanisms is included. Another element in biomedical transport processes is that of momentum transport and fluid flow. This describes how blood is propelled from the heart and throughout the cardiovascular system, how blood elements affect the body, including gas exchange, infection control, clotting of blood, and blood flow resistance, which affects cardiac work. A discussion of the measurement of the blood resistance to flow (viscosity), blood flow, and pressure is also included. A third element in transport processes in the human body is that of heat transfer, including heat transfer inside the body towards the periphery as well as heat transfer from the body to the environment. A discussion of temperature measurements and body protection in extreme heat conditions is also included. Table of Contents: Biomedical Mass Transport / Biofluid Mechanics and Momentum Transport / Biomedical Heat Transport

Although computer technology has dramatically improved the analysis of complex transport phenomena, the methodology has yet to be effectively integrated into engineering curricula. The huge volume of literature associated with the wide variety of transport processes cannot be appreciated or mastered without using innovative tools to allow comprehen

A clear, user-oriented introduction to the subject of computational transport phenomena, first published in 1997.

Integrated, modern approach to transport phenomena for graduate students, featuring examples and computational solutions to develop practical problem-solving skills.

A Modern Course in Transport Phenomena

Basic Transport Phenomena in Biomedical Engineering, Third Edition

Advanced Heat and Mass Transfer

Modeling Transport Phenomena in Porous Media with Applications

Heat Transfer and Fluid Flow in Biological Processes

The All-in-One Guide to Mass Transport Phenomena: From Theory to Examples and Computation Mass transfer processes exist in practically all engineering fields and many biological systems; understanding them is essential for all chemical engineering students, and for practitioners in a broad range of practices, such as biomedical engineering, environmental engineering, material engineering, and the like. *Mass Transfer Processes* combines a modern, accessible introduction to modeling and computing these processes with demonstrations of their application in designing reactors and separation systems. P. A. Ramachandran's integrated approach balances all the knowledge readers need to be effective, rather than merely paying lip service to some crucial topics. He covers both analytical and numerical solutions to mass transfer problems, demonstrating numerical problem-solving with widely used software packages, including MATLAB and CHEBFUN. Throughout, he links theory to realistic examples, both traditional and contemporary. Theory, examples, and in-depth coverage of differential, macroscopic, and mesoscopic modeling Physical chemistry aspects of diffusion phenomena Film models for calculating local mass transfer rates and diffusional interaction in gas-solid and gas-liquid reaction systems Application of mass transfer models in rate-based separation processes, and systems with simultaneous heat and mass transfer Convective mass transfer: empirical correlation, internal and external laminar flows, and turbulent flows Heterogeneous systems, from laminar flow reactors, diffusion-reaction models, reactive membranes, and electrochemical reactors Computations of mass transfer effects in multicomponent systems Solid-gas noncatalytic reactions for chemical, metallurgical, environmental, and electronic processes Applications in electrochemical and biomedical systems Design calculations for humidification, drying, and condensation systems and membrane-based separations Analysis of adsorption, chromatography, electro dialysis, and electrophoresis

Two-phase nano- and micro-thermal control device research is now proving relevant to a growing range of modern applications, including those in cryogenics, thermal engineering, MEMS, and aerospace engineering. Until now, researchers have lacked a definitive resource that provides a complete review of micro- and nano-scale evaporative heat and mass transfer in capillaries-porous structures. Transport Phenomena in Capillary-Porous Structures and Heat Pipes covers the latest experimental efforts in two-phase thermal control technology research and development. The book covers vaporization heat transfer and hydrodynamic processes occurring in capillary channels and porous structures—paying particular attention to the physical mechanisms of these phenomena. Extensive experimental research activities on unique film and photo materials of boiling inside slits, capillaries, and capillary-porous structures are reviewed. By providing a complete record of research in the field, this volume gives researchers, engineers, and practitioners working on vaporization heat transfer and hydrodynamic processes the findings needed to avoid unnecessary experimental efforts, and will help further the development of this dynamic area of research.

Presenting engineering fundamentals and biological applications in a unified way, this book provides learners 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. For researchers in biomedical engineering.

A Cutting-Edge Guide to Applying Transport Phenomena Principles to Bioengineering Systems Transport Phenomena in Biomedical Engineering: Artificial Organ Design and Development and Tissue Engineering explains how to apply the equations of continuity, momentum, energy, and mass to human anatomical systems. This authoritative resource presents solutions along with term-by-term medical significance. Worked exercises illustrate the equations derived, and detailed case studies highlight real-world examples of artificial organ design and human tissue engineering. Coverage includes: Fundamentals of fluid mechanics and principles of molecular diffusion Osmotic pressure, solvent permeability, and solute transport Rheology of blood and transport Gas transport Pharmacokinetics Tissue design Biartificial organ design and immunoisolation Bioheat transport 541 end-of-chapter exercises and review questions 106 illustrations 1,469 equations derived from first principles

Single and Two-Phase Flows on Chemical and Biomedical Engineering

Principles and Practices

Fluid Transport and Pore Structure

Transport Phenomena in Biological Systems

Transport Phenomena in Dispersed Media

Transport phenomena in plasmas are the relatively slow processes of particle momentum and energy transport systems in a state of mechanical equilibrium. In contrast to neutral gases, these phenomena in plasmas are greatly influenced by self-consistent fields, in particular electric fields. These can produce particle and energy fluxes, in addition t

Transport phenomena are the physical forces and processes by which energy and mass are moved into, out of, and throughout a system. Systems that are changing from one state (phase) to another, such as liquid to gas, are said to be "multiphase." This advanced text, for the first time, teaches the fundamentals of transport phenomena, including the relevant thermodynamics and kinetics, in the context of multiphase systems. Students will find this an accessible guide to the understanding of an often dauntingly complex subject, with ample worked-out examples taken from real-life engineering problems and helpful end-of-chapter problems to help reinforce abstract concepts. *Develops and understanding of the thermal and physical behavior of multiphase systems *Reviews underlying thermodynamics, including thermal equilibria and stability, thermodynamics of surfaces *Covers all types of phase changes, including melting and solidification, sublimation and vapor deposition, boiling, condensation, and evaporation *Ample end-of-chapter problems *Solutions Manual

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.

This unique resource offers over 200 well-tested bioengineering problems for teaching and examinations. Solutions are available to instructors online.

Transport Phenomena in the Cardiovascular System

Biofluid Mechanics

Biotransport: Principles and Applications

Transport Phenomena in Micro Process Engineering

Problems for Biomedical Fluid Mechanics and Transport Phenomena

In this book, the fundamentals of chemical engineering are presented with respect to applications in micro system technology, microfluidics, and transport processes within microstructures. Special features of the book include the state-of-the-art in micro process engineering, a detailed treatment of transport phenomena for engineers, and a design methodology from transport effects to economic considerations. Numerical Modeling in Biomedical Engineering brings together the integrative set of computational problem solving tools important to biomedical engineers. Through the use of comprehensive homework exercises, relevant examples and extensive case studies, this book integrates principles and techniques of numerical analysis. Covering biomechanical phenomena and physiologic, cell and molecular systems, this is an essential tool for students and all those studying biomedical transport, biomedical thermodynamics & kinetics and biomechanics. Supported by Whitaker Foundation Teaching Materials Program; ABET-oriented pedagogical layout Extensive hands-on homework exercises

Introduction to Biotransport Principles is a concise text covering the fundamentals of biotransport, including biological applications of: fluid, heat, and mass transport.

The term 'transport phenomena' describes the fundamental processes of momentum, energy, and mass transfer. This text provides a thorough discussion of transport phenomena, laying the foundation for understanding a wide variety of operations used by chemical engineers. The book is arranged in three parallel parts covering the major topics of momentum, energy, and mass transfer. Each part begins with the theory, followed by illustrations of the way the theory can be used to obtain fairly complete solutions, and concludes with the four most common types of averaging used to obtain approximate solutions. A broad range of technologically important examples, as well as numerous exercises, are provided throughout the text. Based on the author's extensive teaching experience, a suggested lecture outline is also included. This book is intended for first-year graduate engineering students; it will be an equally useful reference for researchers in this field.

The Newman Lectures on Transport Phenomena

Transport Phenomena in Capillary-Porous Structures and Heat Pipes

Transport Phenomena of Foods and Biological Materials

Advanced Transport Phenomena

Biomedical Engineering Challenges

This book is an ensemble of six major chapters, an introduction, and a closure on modeling transport phenomena in porous media with applications. Two of the six chapters explain the underlying theories, whereas the rest focus on new applications. Porous media transport is essentially a multi-scale process. Accordingly, the related theory described in the second and third chapters covers both continuum? and meso?scale phenomena. Examining the continuum formulation imparts rigor to the empirical porous media models, while the mesoscopic model focuses on the physical processes within the pores. Porous media models are discussed in the context of a few important engineering applications. These include biomedical problems, gas hydrate reservoirs, regenerators, and fuel cells. The discussion reveals the strengths and weaknesses of existing models as well as future research directions.

Single and two-phase flows are ubiquitous in most natural process and engineering systems. Examples of systems or process include, packed bed reactors, either single phase or multiphase, absorber and adsorber separation columns, filter beds, plate heat exchangers, flow of viscoelastic fluids in polymer systems, or the enhanced recovery of oil, among others. In each case the flow plays a central role in determining the system or process behavior and performance. A better understanding of the underlying physical phenomena and the ability to describe the phenomena properly are both crucial to improving design, operation and control processes involving the flow of fluids.

Encapsulating 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 riddled 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 course 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.

Providing a foundation in heat and mass transport, this book covers engineering principles of heat and mass transfer. The author discusses biological context, context, and parameter regimes and supplies practical applications for biological and biomedical engineering, industrial food processing, environmental control, and waste management. The book contains end-of-chapter problems and sections highlighting key concepts and important terminology It offers cross-references for easy access to related areas and relevant formulas, as well as detailed examples of transport phenomena, and descriptions of physical processes. It covers mechanisms of diffusion, capillarity, convection, and dispersion.

Solution's Manual - Basic Transport Phenomena in Biomedical Engineering

Transport Phenomena in Biomedical Engineering: Artificial organ Design and Development, and Tissue Engineering

Mass Transfer Processes

Transport Phenomena in Multiphase Systems

Transport Phenomena in Partially Ionized Plasmas

Transport Phenomena in Dispersed Media addresses the main problems associated with the transfer of heat, mass and momentum. The authors focus on the analytical solutions of the mass and heat transfer equations: the theoretical problems of coalescence, coagulation, aggregation and fragmentation of dispersed particles: the rheology of structured aggregate and kinetically stable disperse systems: the precipitation of particles in a turbulent flow, the evolution of the distribution function: the stochastic counterp mass transfer equations: the dissipation of energy in disperse systems: and many other problems that distinguish this book from existing publications. Key Selling Features Covers all technological processes taking place in the oil and gas complex, as well as in the petrochemical industry Presents new original solutions for calculating design as well as for the development and implementation of processes of chemical technology Organized to first provide an extensive review of each chapter topic, solve specific problem and then review the solutions with the reader Contains complex mathematical expressions for practical calculations Compares results obtained on the basis of mathematical models with experimental data

The fourth edition of Transport Phenomena Fundamentals continues with its streamlined approach to the subject, based on a unified treatment of heat, mass, and momentum transport using a balance equation approach. The new edition includes more worked examples within each chapter and adds confidence-building problems at the end of each chapter. Some numerical solutions are included in an appendix for students to check their comprehension of key concepts. Additional resources online include exercises that be practiced using a wide range of software programs available for simulating engineering problems, such as, COMSOL(R), Maple(R), Fluent, Aspen, Mathematica, Python and MATLAB(R), lecture notes, and past exams. This edition incorporates a wider range of problems to expand the utility of the text beyond chemical engineering. The text is divided into two parts, which can be used for teaching a two-term course. Part I covers the balance equation in the context of diffusive transport—momentum, energy, mass, and heat transfer—and the balance equation, highlighting that term's effects on the physical behavior of the system and the underlying mathematical description. Chapters familiarize students with modeling and developing mathematical expressions based on the analysis of a control volume, the derivation of the governing differential equations, and the solution to those equations with appropriate boundary conditions. Part II builds on the diffusive transport balance equation by introducing convective transport t focusing on partial, rather than ordinary, differential equations. The text describes paring down the full, microscopic equations governing the phenomena to simplify the models and develop engineering solutions, and it introduces macroscopic versions of the balance equations for use where the microscopic approach is either too difficult to solve or would yield much more information that is actually required. The text discusses the momentum, Bernoulli, energy, and species continuity equations, including a brief description of how these equations are applied to heat exchangers, continuous contactors, and chemical reactors. The book introduces the three fundamental transport coefficients: the friction factor, the heat transfer coefficient, and the mass transfer coefficient in the context of boundary layer theory. Laminar flow situations are treated first followed by a discussion of turbulence. The final chapter covers the basics of radiative heat transfer, including concepts such as blackbodies, graybodies, radiation shields, and enclosures.

This textbook provides a thorough presentation of the phenomena related to the transport of mass, momentum and energy. It lays all the basic physical principles, then for the more advanced readers, it offers an in-depth treatment with advanced mathematical derivations and ends with some useful applications of the models and equations in specific settings. The important idea behind the book is to unify all types of transport phenomena, describing them within a common framework in terms of cause and effect, rather than by the differing way the transported quantity. The approach and presentation are original in that the book starts with a general description of transport processes, providing the macroscopic balance relations of fluid dynamics and heat and mass transfer, before diving into the mathematical realm of continuum mechanics to derive the microscopic governing equations at the microscopic level. The book is a modular teaching tool and can be used either for an introductory or for an advanced course. The last 6 chapters will be of interest to more advanced researchers who might be interested in particular applications in physics, mechanical engineering or biomedical engineering. All chapters are complemented with exercises that are essential to complete the learning process.

This book examines the relationship between transport properties and pore structure of porous material. Models of pore structure are presented with a discussion of how such models can be used to predict the transport properties of porous media. Portions of the book are devoted to interpretations of experimental results in this area and directions for future research. Practical applications are given where applicable, and are expected to be useful for a large number of different fields, including reservoir engineering, hydrogeology, soil science, chemical process engineering, biomedical engineering, fuel technology, hydrometallurgy, nuclear reactor technology, and materials science. Presents mechanisms of immiscible and miscible displacement (hydrodynamic dispersion) process in porous media Examines relationships between pore structure and fluid transport Considers approaches to enhanced oil recovery Explores network modeling and perolation theory

Introduction to Biomedical Engineering

Modeling, Computations, and Design

Basic Transport Phenomena in Biomedical Engineering, 2nd Edition

Essentials of Micro- and Nanofluidics

Transport Phenomena in Biomedical Engineering

Transport Phenomena of Foods and Biological Materials provides comprehensive coverage of transport phenomena modeling in foods and other biological materials. The book is unique in its consideration of models ranging from rigorous mathematical to empirical approaches, including phenomenological and semi-empirical models. It examines cell structure and descriptions of other non-traditional models, such as those based on irreversible thermodynamics or those focused on the use of the chemical and electrical potential as the driving forces of transport. Other topics discussed include the source term (important for the coupling transport phenomena-reaction or other intentional/unintentional phenomena) and the connections between transport phenomena modeling and design aspects. Some 100 tables provide useful summaries of the characteristics of each model and provide data about the transport properties of an extensive variety of foods. Transport Phenomena of Foods and Biological Materials will benefit a broad audience of chemists, biochemists, biotechnologists, and other scientists in the academic and industrial realm of foods and biological materials.

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Prof. Newman is considered one of the great chemical engineers of his time. His reputation derives from his mastery of all phases of the subject matter, his clarity of thought, and his ability to reduce complex problems to their essential core elements. He is a member of the National Academy of Engineering, Washington, DC, USA, and has won numerous national awards including every award offered by the Electrochemical Society, USA. His motto, as known by his colleagues, is "do it right the first time." He has been teaching undergraduate and graduate core subject courses at the University of California, Berkeley (UC Berkeley), USA, since joining the faculty in 1966. His method is to write out, in long form, everything he expects to convey to his class on a subject on any given day. He has maintained and updated his lecture notes from notepad to computer throughout his career. This book is an exact reproduction of those notes. This book demonstrates how to solve the classic problems of fluid mechanics, starting with the Navier-Stokes equation. It explains when it is appropriate to simplify a problem by neglecting certain terms through proper dimensional analysis. It covers concepts such as microscopic interpretation of fluxes, multicomponent diffusion, entropy production, nonnewtonian fluids, natural convection, turbulent flow, and hydrodynamic stability. It amply arms any serious problem solver with the tools to address any problems.

This text is designed for a first course in biological mass transport, and the material in it is presented at a level that is appropriate to advanced undergraduates or early graduate level students. Its orientation is somewhat more physical and mathematical than a biology or standard physiology text, reflecting its origins in a transport course that I teach to undergraduate (and occasional graduate) biomedical engineering students in the Whiting School of Engineering at Johns Hopkins. The audience for my cours- and presumably for this text - also includes chemical engineering undergraduates concentrating in biotechnology, and graduate students in biophysics. The organization of this book differs from most texts that at tempt to present an engineering approach to biological transport. What distinguishes biological transport from other mass transfer processes is the fact that biological transport is biological. Thus, we do not start with the engineering principles of mass transport (which are well presented elsewhere) and then seek biological ap plications of these principles; rather, we begin with the biological processes themselves, and then develop the tools that are needed to describe them. As a result, more physiology is presented in this text than is often found in books dealing with engineering applica tions in the life sciences.

Fundamentals of Biomedical Transport Processes

Numerical Methods in Biomedical Engineering

With Applications to the Biological and Chemical Sciences

Numerical Methods for the Solution of Transport Problems

Computational Transport Phenomena for Engineering Analyses