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The terms "multiscale" and "multiphysics" are adequately descriptive of the direction this effort is taking.1,35 Many clinically relevant problems in cardiovascular biomedical engineering involve either spatially/temporally diverse scales or multiple mechanisms at intricate interplay with each other, or a combination of both. Examples like the following point up their prevalence in cardiovascular biomechanics: multi-bifurcation simulations, coupling of electrophysiology and perfusion ...

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With support from an NSF grant, two faculty members in biomedical engineering and mechanics have combined forces to answer questions pertaining to insects' breathing. The researchers will study how oxygen is delivered in insects' bodies within some of their tiniest tubes, which may lead to new applications in microfluidics.

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

How does one deal with a moving control volume? What is the best way to make a complex biological transport problem tractable? Which principles need to be applied to solve a given problem? How do you know if your answer makes sense? This unique resource provides over two hundred well-tested biomedical engineering problems that can be used as classroom and homework assignments, quiz material and exam questions. Questions are drawn from a range of topics, covering fluid mechanics, mass transfer and heat transfer applications. Driven by the philosophy that mastery of biotransport is learned by practice, these problems aid students in developing the key skills of determining which principles to apply and how to apply them. Each chapter starts with basic problems and progresses to more difficult questions. Lists of material properties, governing equations and charts provided in the appendices make this a fully self-contained work. Solutions are provided online for instructors.

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 readable and attractively presented textbook on fluid flow in biological systems that includes flow through blood vessels, pulsatile flow, and pattern formation. It bridges the divide among biomedical engineering students between those with an engineering and those with a bio-scientific background, by offering guidance in both physiological and mathematical aspects of the subject. Every chapter includes surprising, amusing, and stimulating effects that the reader may want to experiment on their own. Brief historical vignettes are also included throughout this book. We in the 21st century can so easily turn to the computer to provide a solution, that we forget the extraordinary sparks of insight that scientists in centuries past had to rely on to provide us with the foundational understanding and analytical tools that we now depend on. This book is an attempt to maintain our roots in past investigations, while giving us wings to explore future ones.

Biofluid Mechanics is a thorough reference to the entire field. Written with engineers and clinicians in mind, this book covers physiology and the engineering aspects of biofluids. Effectively bridging the gap between engineers' and clinicians' knowledge bases, the text provides information on physiology for engineers and information on the engineering side of biofluid mechanics for clinicians. Clinical applications of fluid mechanics principles to fluid flows throughout the body are included in each chapter. All engineering concepts and equations are developed within a biological context, together with computational simulation examples as well. Content covered includes; engineering models of human blood, blood rheology in the circulation system and problems in human organs and their side effects on biomechanics of the cardiovascular system. The information contained in this book on biofluid principles is core to bioengineering and medical sciences. Comprehensive coverage of the entire biofluid mechanics subject provides you with an all in one reference, eliminating the need to collate information from different sources Each chapter covers principles, needs, problems, and solutions in order to help you identify potential problems and employ solutions Provides a novel breakdown of fluid flow by organ system, and a quick and focused reference for clinicians

This book presents, in a methodical way, updated and comprehensive descriptions and analyses of some of the most relevant problems in the context of fluid-structure interaction (FSI). Generally speaking, FSI is among the most popular and intriguing problems in applied sciences and includes industrial as well as biological applications. Various fundamental aspects of FSI are addressed from different perspectives, with a focus on biomedical applications. More specifically, the book presents a mathematical analysis of basic questions like the well-posedness of the relevant initial and boundary value problems, as well as the modeling and the numerical simulation of a number of fundamental phenomena related to human biology. These latter research topics include blood flow in arteries and veins, blood coagulation and speech modeling. We believe that the variety of the topics discussed, along with the different approaches used to address and solve the corresponding problems, will help readers to develop a more holistic view of the latest findings on the subject, and of the relevant open questions. For the same reason we expect the book to become a trusted companion for researchers from diverse disciplines, such as mathematics, physics, mathematical biology, bioengineering and medicine.

Designed for introductory undergraduate courses in fluid mechanics for chemical engineers, this stand-alone textbook illustrates the fundamental concepts and analytical strategies in a rigorous and systematic, yet mathematically accessible manner. Using both traditional and novel applications, it examines key topics such as viscous stresses, surface tension, and the microscopic analysis of incompressible flows which enables students to understand what is important physically in a novel situation and how to use such insights in modeling. The many modern worked examples and end-of-chapter problems provide calculation practice, build confidence in analyzing physical systems, and help develop engineering judgment. The book also features a self-contained summary of the mathematics needed to understand vectors and tensors, and explains solution methods for partial differential equations. Including a full solutions manual for instructors available at www.cambridge.org/deen, this balanced textbook is the ideal resource for a one-semester course.

Introductory Biomechanics is a new, integrated text written specifically for engineering students. It provides a broad overview of this important branch of the rapidly growing field of bioengineering. A wide selection of topics is presented, ranging from the mechanics of single cells to the dynamics of human movement. No prior biological knowledge is assumed and in each chapter, the relevant anatomy and physiology are first described. The biological system is then analyzed from a mechanical viewpoint by reducing it to its essential elements, using the laws of mechanics and then tying mechanical insights back to biological function. This integrated approach provides students with a deeper understanding of both the mechanics and the biology than from qualitative study alone. The text is supported by a wealth of illustrations, tables and examples, a large selection of suitable problems and hundreds of current references, making it an essential textbook for any biomechanics course.

Improve Your Grasp of Fluid Mechanics in the Human Circulatory System_and Develop Better Medical Devices Applied Biofluid Mechanics features a solid grasp of the role of fluid mechanics in the human circulatory system that will help in the research and design of new medical instruments, equipment, and procedures. Filled with 100 detailed illustrations, the book examines cardiovascular anatomy and physiology, pulmonary anatomy and physiology, hematology, histology and function of blood vessels, heart valve mechanics and prosthetic heart valves, stents, pulsatile flow in large arteries, flow and pressure measurement, modeling, and dimensional analysis.

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