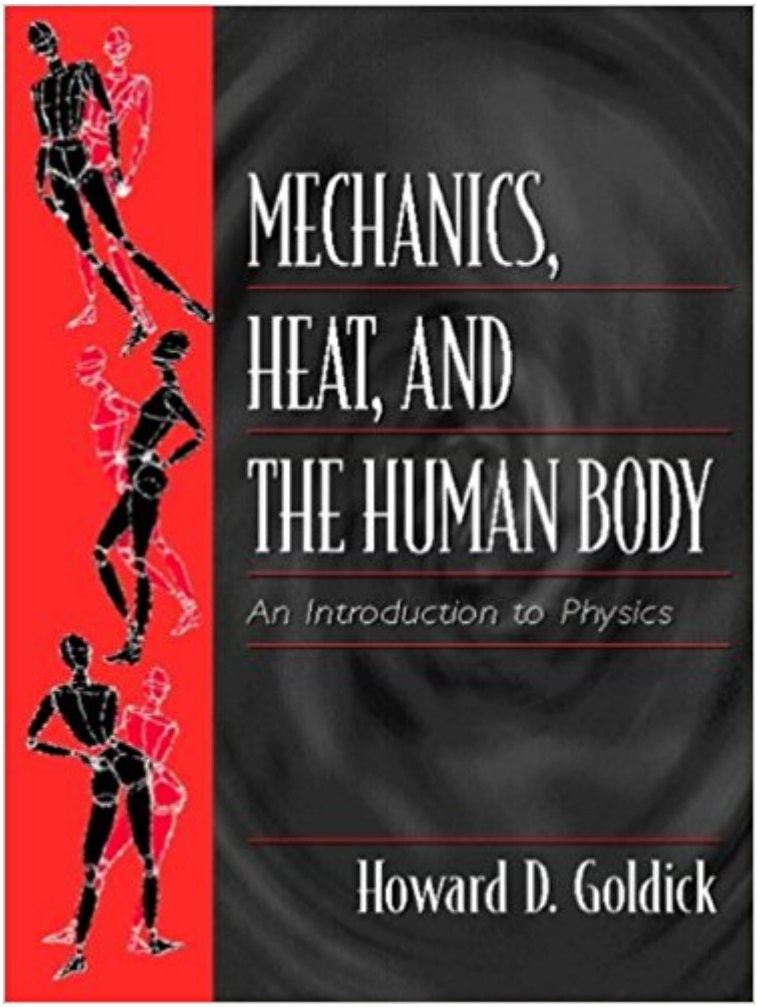
Mechanics, Heat, And The Human Body: An Introduction To Physics



Synopsis

This unique introduction to physics for readers who are particularly interested in the human body covers a limited number of distinct physics topics (related to mechanics and heat) in great depth and with many examples and problems that relate directly to readers' interests. Each topic is developed quantitatively using high school-level algebra (linear equations, simultaneous equations), trigonometric functions, and vectors. Applications focus on typical situations--e.g., the need for and proper use of a cane; the need for heat transfer from the body to the environment during exercise and the relative contributions of the various mechanisms (convection, radiation, evaporation of sweat); the relation between energy ingested as food and energy expended during exercise; etc. Motion; Force; Vectors; Newton's Second Law; Momentum And Impulse; Angular Motion; Torque; Shoulder; Knee; Lower Back; FHP; Heat And Energy; Conservation Of Energy; Work; Chemical Energy; Elastic Energy; Nuclear Energy. For premedical students, Physical Therapists, and Occupational Therapists.

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Customer Reviews

The first basic physics book written specifically for students pursuing careers in physical and occupational therapy, Mechanics, Heat and the Human Body emphasizes physics principles as they relate to the human body. Using a wealth of problems taken from human and animal anatomy and physiology, this accessible book provides readers with an understanding of the physics that influence human movement. FEATURES Presents a wide range of examples and problems that

demonstrate basic physics concepts as they relate to human movement, increasing readers' understanding of both physics and why and how physical therapy methods work. Emphasizes topics such as equilibrium problems involving joints (e.g., hip, knee, elbow, and lower back), heat generation within the body, and heat transfer both within the body and between the body and the environment. Each topic is developed quantitatively using high-school-level algebra (linear equations, simultaneous equations), trigonometric functions, and vectors, making topics more accessible to readers. SI and USA systems of units are used throughout, allowing readers to use the system with which they are most familiar.

PREFACE In writing this book, I had the goal of providing an introduction to physics for those students who are particularly interested in the human body. On the basis of my many years of teaching physics to premedical, physical therapy and occupational therapy students, I set these guidelines: The text would cover a limited number of distinct physics topics rather than providing an encyclopedic survey of the field of physics. These topics would be illustrated (examples and problems) with reference to specific functions and characteristics of the human body. The material would be covered in greater depth than is typical of an introductory text. This provides an opportunity to demonstrate the roles that physics. and mathematical analysis play in understanding the body. The examples and problems would span a range from straightforward applications of basic physics principles to those requiring significant analysis. My students have, during the past five years, used the notes on which the text is based as a standalone text for a one-semester course. Much of the present content is based on their questions, criticisms, and suggestions. For example: The discussion of each topic is built around a series of steps on which the analysis is based. Both the SI and USA (English) systems of units are used in the book. Although the SI system is the legal system in this country and is the most commonly used system in the sciences, it is not widely used outside of those fields. Therefore, most students are much more familiar with the USA system, and this familiarity is addressed by inclusion of the USA system. The various tables indicate sources of the data in the bibliography. Answers to all of the quantitative problems are included. I strongly suggest that students who use this book do not limit their efforts to reading it. To derive the full benefits that I hope are present, it is necessary that during your reading, you fill in any gaps between equations. There should be no "magic," no material that seems to come from nowhere. Do as many problems as your time allows. In your analyses of these problems, follow the suggested procedures rather than using shortcuts. Each analysis should include the basic applicable physics principle and clearly show how it is used. The answers to all problems are given.

Do not work from these answers backward to produce your analysis. Such an approach is self-defeating because you will not be given the answers on exams or if you enter a field in which you must carry out such analyses. One last comment: This text is intended to be a physics book, not an anatomy or physiology text. The human body is extremely complex, and to deal with its functions at an introductory level, many simplifications have been made. Modeling is employed; for example, muscles are treated as if they are simple line forces. Nevertheless, the results of the analyses are illustrative of the body's functions. I look forward to your comments and questions regarding the book. Please contact me via e-mail at goldick@mail.hartford.edu. INTRODUCTION Our understanding of the human body and the means by which we deal with maladies and injuries have undergone amazing changes during the last 100 years. Illnesses that had been viewed as the result of Divine Intervention are now viewed in terms of the effects of bacteria and/or viruses. Amputation was a common medical response to severe trauma to limbs but is now very rare. The field of prosthetics has advanced to such a degree that those who have lost limbs are no longer doomed td living a marginal life but may now lead so full a life that it is sometimes difficult to realize that they have such a handicap. In the past, a person who had suffered a spinal cord injury that resulted in loss of the use of his or her legs could look forward only to life in a wheelchair. A person suffering that injury today can reasonably hope to walk and even climb stairs. Whereas exploratory surgery was common in the past, it is now very rare, having been replaced by noninvasive means. These and many other medical advances testify to the central role that the physical sciences and technology play in our dealings with the human body. In this text, we will deal with the application of certain aspects of physics (mechanics and heat) to the human body. We will answer questions such as the following: If a 150-pound woman were standing while holding a 10-pound child, how much force would be acting to compressing her lower back? (About 109 pounds) She bends over to put the child down into a playpen. How much force is now compressing her lower back? (439 pounds) (See page 109.) Why does a person who has injured his right hip lean toward his right when walking? Why should he use a cane on his left rather than his right side? (See pages 113-115.) What is the average power output of a catcher while stopping a fastball? (5 hp) (See page 146.) How many times would you have to curl an 11-pound weight to burn off the energy you take in by eating six chocolate chip cookies? (5000) (See page 171.) You know that your body produces heat when you exercise. How does the rate at which your body produces heat compare to the rate at which a 100-watt lightbulb produces heat? Surprisingly, even when you are not exerting yourself, as while lying still in bed, you are producing heat at a rate comparable to that of the lightbulb. (See page 148.) Why does your body seems to produce and retain fat so easily, and why is it so difficult

to lose the fat? (See page 150.) What is the function of kneecaps? (See page 192.) Why is your spinal column curved rather than straight? (See page 97.) Why does a pregnant woman usually lean backward when standing? (See page 97.) How is it possible for a cold-blooded animal such as a tuna or a shark to have an internal temperature that is higher than that of the cold water in which it swims? (See page 188.) As we learn how to analyze these and many other situations, we will become familiar with concepts that are basic to physics, such as Newton's laws and conservation of energy. We will also learn about the anatomy and physiology of the human body; in particular, we will deal with the muscular-skeletal system, digestion, and temperature regulation systems. Perhaps more important than this information, which can be found in many books, is the techniques of analysis and quantitative reasoning that we will develop. In my opinion, it has been the application of these techniques that has made possible the amazing advances in medicine and health care in general that we enjoy today. HISTORICAL BACKGROUND Our efforts to understand or explain the world seem to be inherent. Evidence for this statement comes from such diverse areas of study as comparative mythology and child psychology. Just as a child repetitively asks "Why?" and seems never to be satisfied by the answers, so it was with our ancestors. Unfortunately, this attitude is not supported by contemporary culture and has been replaced by a sort of sophistication and noncritical collective agreement characterized by

I am the author of the book, so please excuse the 5 stars. The purpose of this note is to let anyone who is interested know that I have a web site, morpheus.hartford.edu/~goldick. On the site I maintain a list of errors and re-writes for the book. They are listed by date and by page. I hope that this is useful to all who are using the book.I would very much appreciate comments about the book from any reader and also notification of errors.There is an instructor's manual available from the publisher.

This book is must for all Physics lovers!!! Equally useful for undergraduate students who are curious to learn the fundamentals of Mechanics, Heat, and the Human Body as well as advanced PhD students who are looking for some innovative research ideas! Highly recommended!!

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