

A Few Words at the Beginning

Gunther Lehmann published his book “Practical Work Physiology” (Praktische Arbeitsphysiologie, Stuttgart, Thieme) in 1953. He used to say, with his little smile, that some of his learned colleagues accused him of over-simplifying a difficult subject matter while engineers and managers still marveled the complexities of the human body. His book was translated into four languages, and it had its second edition in 1962. The first edition of our “Engineering Physiology”, published in 1986, followed Professor Lehmann’s path and we received similar comments – and the widespread use of that book caused follow-up editions in 1990 and 1997, and now again in 2010.

This fourth edition of Engineering Physiology has the same purpose as the earlier prints: to provide physiological information which engineers, designers, managers and all other persons need who want to make work and equipment “fit the human”.

All chapters have been revised, figures and tables updated. New material is in all chapters of this new edition, especially as it relates to:

- Recent experiences with biomechanics and modeling of the body.
- Modern replacements of deteriorated and damaged body parts.
- Effects of shift work on body functions, attitude and performance.
- Changes in body sizes and in measurement techniques, and the resultant changes in applications of that information.

Even an audacious engineer wouldn’t dare to devise a system as complicated as the human body. Yet, devices that engineers design, from simple tools to complicated systems, must fit the humans who use them. Therefore, everybody who is interested in human-centered engineering needs to understand how the human body functions, what it can barely tolerate or, better, do with ease.

We chose the title “Engineering Physiology” in the 1980s to indicate our treatment of the topic. The book does not take the place of the standard (biological-medical-chemical) textbook on human physiology; instead, it models and describes the human body in terms that provide practical, design-directed information on essential features and functions.

Regarding “models”:

When developing models we must realize that selecting certain features, drawing distinctions, making classifications usually imposes artificial divisions of our own choosing upon a universe that is, in many ways, all in one piece. We do such modeling because it helps us in our attempted understanding of the intricate system. It breaks down a set of objects and phenomena too complex to be grasped in their entirety into smaller realms that we can deal with one by one. There is nothing objectively “true” about such models; the only proper criterion of their value is their usefulness. (This is, slightly paraphrased, Isaac Asimov’s observation on page 13 in his 1963 book “The Human Body”. New York, Signet.)

Such understanding provides the underpinnings for devising work tasks, tools, workplaces, vehicles, work-rest schedules, human-machine systems, homes and designed environments so that we humans can work and live safely, efficiently and comfortably. This is the field of *ergonomics* or *human (factors) engineering*, terms often used interchangeably.

This book also helps lay the foundations for teamwork among engineers and physiologists, chemists, biologists and physicians to create repairs and replacements for worn and damaged parts of the body. Such “bioengineering” topics concern cells and tissues, neural networks, biochemical processes, anthropomechanics, bio-nanotechnology, biosensors and prosthetics, to mention just a few areas of common interest.

About References in This Edition

Basic human physiological characteristics did not change in recent years. The previous editions of this book contain exhaustive listings of pre-1997 publications on human physiology. We don’t want to repeat those lists here, so we suggest that the reader interested in history return to the earlier editions or check current physiology textbooks. In this 4th edition we are referring mostly to recent publications, along with a few selected classic references.

Traditional practice was to support statements in the text by listing the names of the authors, and of their co-authors, who wrote previously on that topic. That wordy custom disrupts the flow of reading, especially when there are strings of names and dates. To avoid that problem, we follow other authors’ and our earlier practice of simply placing a small marker, *, in the text where references or explanations are desired. These appear, at the end of the chapter, in a separate “Notes” section, which the reader may skip or consult.

We Would Like to Hear from You!

We appreciate your comments, which tell us what we did well and what we should do better. You can contact us at kroemer@vt.edu.

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