

A FIRM FOUNDATION FOR ASPIRING BIOPHYSICISTS

Intermediate Physics for Medicine and Biology

Russell K. Hobbie

Wiley, New York, 1988.

Second edition. 623 pp.

\$54.60 hc ISBN 0-471-82851-3

Solutions Manual to Accompany Intermediate Physics for Medicine and Biology

Russell K. Hobbie

Wiley, New York, 1988.

Second edition. 273 pp.

\$14.50 pb ISBN 0-471-82852-1

Reviewed by John P. Wikswo Jr

In our introductory physics courses as well as in our daily use of physics, we regularly encounter the early work of Galileo, Isaac Newton, Luigi Galvani, Alessandro Volta, Thomas Young, Jean Poiseuille, Julius Mayer, Hermann von Helmholtz, William Gilbert and Jacques d'Arsonval. Many of us fail to recognize that the first four were *physicists* who in the course of their studies of physical systems made major contributions to the life sciences, while the remainder were *physicians* whose fundamental contributions to physics were largely motivated by their interests in biology and medicine. In the past 40 years, the Nobel Prize in Physiology or Medicine has been awarded to a remarkable number of physicists, including Hugo Theorell, Georg von Békésy, Francis Crick, Maurice Wilkins, Alan Hodgkin, Andrew Huxley, Haldan Hartline, Max Delbrück, Rosalyn Yalow, Allan Cormack and Geoffrey Hounsfield. There must be a multitude of reasons why each of these modern-

day physicists chose a career that spanned both physics and the life sciences, but it is unlikely that any single book, with the possible exception of Erwin Schrödinger's *What is Life?*, could have been the stimulus. Why are there so few books that successfully span physics, medicine and biology?

While there are excellent texts, treatises and reviews of medical and radiological physics and biophysics, none of these provides the breadth and depth required of a guidebook for a physicist or biologist desiring to explore, possibly for the first time, the realm where physics joins medicine and biology. The problem in part is that such a book should develop simultaneously both the physics and the biology without assuming extensive prior knowledge of either, and yet should explore the subject with sophistication and quantitative rigor. In 1977, I was confronting the dilemma of finding no suitable text for the very first physics course I had been assigned to teach, an introductory medical physics course for undergraduate premedical students, when a friend from the Mayo Clinic told me that Russell Hobbie of the University of Minnesota was writing just the book I needed. For two years my students and I learned from typed manuscripts kindly provided by Hobbie, and my colleagues and I have been using the first edition of *Intermediate Physics for Medicine and Biology* ever since then. This year, we can greet our students with the second edition.

As detailed in the preface, Hobbie was motivated to write this textbook by noting how much physics was contained in the courses for the first two years of medical school, and how little of this material was presented in the typical general physics course required in the premedical curriculum. Similarly, much of the biological literature, for example, in electrophysiology, contains sophisticated physics and mathematics, but undergraduate

biology majors seldom see more than a year of introductory physics. In writing a book to address these needs, Hobbie has performed a great service not only to undergraduates but also to graduate students, faculty and professional scientists in both physics and the life sciences. The ability of the book to be useful to such a spectrum of readers results from the stated principles of its design: Calculus is used without apology, but with adequate appendices; it is assumed that the reader is already familiar with the basic vocabulary of physics, but that logical development of ideas from first principles is needed; steps are not omitted from derivations; the book does not attempt to span the entire distance from introductory physics to the frontiers of research; and each subject is presented as simply and concisely as possible.

The book has 17 chapters and over 600 pages, and would take up to three semesters to cover in its entirety. Hobbie begins by discussing biomechanics, hydrodynamics, exponential growth and decay, statistical mechanics, and transport phenomena in infinite media and neutral membranes, and in doing so familiarizes the reader with a number of techniques used extensively throughout the rest of the book. The chapters related to electrophysiology cover transport through charged membranes, the electrical properties of nerves and the heart, and biomagnetism. Additional techniques are introduced in chapters that cover feedback and control, least-squares techniques, signal analysis and image reconstruction. One-quarter of the book is devoted to subjects related to radiological and medical physics, with chapters on atoms and light, the interaction of photons and charged particles with matter, x rays and dosimetry, nuclear physics and nuclear medicine, and magnetic resonance imaging. Fourteen appendices cover the requisite calculus and statistics. One appendix contains tables of data describing the

John Wikswo is a professor of physics at Vanderbilt University. His research uses electric and magnetic measurements and electromagnetic theory to study the propagation of electrical activity in nerve and muscle cells.