

the most exciting developments of the past few decades will find more than enough material in Rohlfs's book.

There are a few pedagogical weaknesses that limit the utility of this book as a text in a modern physics course. Its coverage is massive for a one-semester course, and its style is quite terse. Often the most important aspect of a new concept is given first, followed by a good deal of discussion and the requisite development. A student who requires ample background, a logical development of new concepts and carefully selected examples will be frustrated. There are more than the typical number of examples scattered throughout the text, but most call for the mere plugging of numbers into formulae. The examples suffer as well from a layout that does not clearly mark the end of an example; readers may often think the discussion is still about the example when in fact it is a continuation of the text preceding the example.

The level and coverage are similar to Robert Eisberg and Robert Resnick's *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles* (Wiley, 1985), and it is more advanced than *Modern Physics* by Raymond A. Serway, Clement J. Moses and Curt A. Moyer (Saunders College, 1989). The inclusion of so many contemporary topics and the up-to-date nature of the discussion, however, set it apart from other modern physics texts.

PETER J. COLLINGS

*Swarthmore College
Swarthmore, Pennsylvania*

Glass Science

Robert H. Doremus

Wiley, New York, 1994.

Second edition. 339 pp.

\$74.95 hc ISBN 0-471-89174-6

This book is the first revision and expansion of a text published more than 20 years ago. The original volume has served as a valuable reference and course textbook on glass science for both students and researchers in the field. In this new edition, Robert Doremus provides a broad, updated overview of the fundamental structure and microstructure of glasses, as well as treatments of their mechanical, optical, chemical and electrical properties. The focus, however, is the basic understanding of glasses rather than a comprehensive compilation or tabulation of properties. Some of the topics covered are glass formation and processing, phase separation, viscous behavior, surface properties, gaseous diffusion and interactions, chemical durability, and

ionic exchange and transport. The author has also introduced substantial new material on subjects or glasses that have emerged or grown in significance in recent years, such as fast-ion conductors, heavy-metal fluoride glasses and glass corrosion and dissolution in water.

Doremus's book serves as both an introduction and a reference to the current field of glass science. It should prove useful as a textbook for advanced undergraduate and first-year graduate students, as well as an updated, broadly based reference for researchers and technologists working in the field. While a large number of books have appeared in recent years on such specialized glass topics as sol-gels, fluorides, optical fibers, bioglasses and glass ceramics, there are very few books like this one, which provides a comprehensive overview of glass in a single volume. One disappointment, however, at least from my perspective, is the limited discussion and updating of the section on optical properties, although the author does provide an excellent list of references in this area. Nonetheless, if one is to have only a single reference on glassy materials on the shelf, this book is certainly a good candidate.

The author has had a distinguished career in both industry and academia, first with the General Electric Research Laboratory in Schenectady, New York and, since 1971, as a faculty member in the materials engineering department at Rensselaer Polytechnic Institute, where he is the New York Professor of Glass and Ceramics. He thus merges the insights and expertise of an academic researcher with the practical experience of an industrial scientist as he selects and presents his material, never losing sight of the need for a definitive university textbook on glass science.

GEORGE H. SIGEL JR

*Rutgers University
New Brunswick, New Jersey*

Stochastic Dynamical Systems

Joseph Honerkamp

VCH, New York, 1994.

535 pp. \$100.00 hc

ISBN 1-56081-563-9

Stochastic Dynamical Systems is an excellent translation (by Kata Lindenberg) and expansion of the German edition published in 1989. As a neophyte in stochastic processes, I approached it with the fervent hope that it would expand my knowledge of deterministic dynamical systems to in-

clude the stochastic variety. However, despite its title, this book is not really about stochastic dynamical systems, which would pertain to the qualitative analysis of dynamical models. It is instead an introduction to stochastic processes and stochastic differential equations. Stochastic dynamical systems are the focus of recent research publications by Ludwig Arnold and his collaborators (for example, Arnold and Hans Crauel's "Random Dynamical Systems", in *Lecture Notes in Mathematics 1486*, Springer-Verlag, 1991), but I was hoping for a textbook treatment.

On the other hand, the need for a text like Honerkamp's is clear. As the author states in his preface, "Probability theory is not afforded the appropriate attention" in classical theoretical physics courses, even though probabilistic techniques—ranging from data analysis to the modeling of complex systems—are essential tools for physicists. He attempts in this book to remedy this situation. *Stochastic Dynamical Systems* is written as a text for a graduate course in probability and stochastic processes, and its level makes it accessible to first-year graduate students. Its scope is vast, which, I believe, is both its major advantage and its major shortcoming. I can best illustrate this by trying to delineate the range of topics covered.

The initial chapters of the book cover basic notions of probability theory—from the definition of a random variable to such notions as cumulants and factor analysis. As is appropriate for a physics text, there is mention, but no extensive use, of such concepts as Borel sets, nor is the notation onerously mathematical.

Subsequent chapters cover the analysis of linear stochastic differential equations, Brownian motion, Fokker-Planck equations, path integral methods and even graph theoretic techniques for perturbation solution of nonlinear stochastic differential equations. There is a succinct, practical guide to the different calculi (Stratonovich and Ito) for the treatment of systems with white noise ("In physical equations one tends to choose the Stratonovich interpretation [because] white noise is always an idealization"). The final sections cover data analysis, with an extensive treatment of time series by linear filtering and autoregressive moving average methods. A major omission is a discussion of recent nonlinear methods for the fitting of time series. This topic is extensively covered in volume 58 of *Physica D* and in the review by Henry Abarbanel *et al.* in

Physics Reports **65**, 1331 (1993).

One unique aspect of this book is its emphasis on numerical techniques, ranging from a brief discussion of algorithms for pseudo-random number generators and Monte Carlo techniques for problems such as the Ising model to moment expansion techniques for stochastic differential equations. Unfortunately, the treatment is all too brief, and we must refer to such definitive works as Donald Knuth's *Seminumerical Algorithms* (Addison Wesley, 1969) for the complete story.

Except for its price, this text would be appropriate for a first- or second-year physics graduate course on stochastic processes and probability methods. I do not recommend it as a definitive treatment of these subjects, however, since the broad range of topics limits its depth. And I am still looking for a book that really is about stochastic dynamical systems.

JAMES D. MEISS

University of Colorado, Boulder

Semiconductor Optoelectronic Devices

Pallab Bhattacharya

Prentice-Hall, Englewood

Cliffs, N. J., 1994. 535 pp.

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The invention of semiconductor lasers in 1962 and the success of optical fibers as a new information transmission medium have led to enormous progress in optoelectronics over the past two decades. It is difficult as well as time-consuming to seek the essence of this rapidly growing field through scattered materials in the journal literature and a half-dozen texts and treatises. Pallab Bhattacharya's *Semiconductor Optoelectronic Devices* summarizes the important aspects of the field, along with recent experimental results, in a clear and coherent fashion. As such, it is a good introductory textbook for senior-level undergraduate and first-year graduate students. It can also serve as a tutorial book for those who wish to enter optoelectronics.

The first four chapters lay the foundation for an understanding of the operating principles of various optoelectronic devices: Bhattacharya has succeeded in providing a clear and elementary treatment of the fundamental concepts of crystallography and epitaxy, electronic properties, optical processes and junction theory of semiconductors. I was amazed at

how well those four chapters gave me a focused and coherent review of the materials necessary to an understanding of the device operations. The rest of the book—eight chapters and eleven appendixes in all—gives a good, comprehensive survey of various semiconductor optoelectronic devices: lasers, light-emitting diodes, solar cells, photodetectors, modulators and switches.

In presenting the principles of device operation, Bhattacharya emphasizes physical pictures along with the mathematical derivations. The physical explanation is clear and well written. I was impressed by the simplicity of the explanations and arguments. To help readers gain a clear physical understanding of the relevance of the mathematics and a feeling for real values, Bhattacharya includes device applications, measurement techniques and recent experimental results, in addition to the theoretical treatments. The level of detailed derivations of equations presented in the chapters is appropriate, and more details are given in the appendixes. A reader will not have to consult the book's list of references or the suggested reading list to learn about semiconductor optoelectronic devices, nor will the reader be lost in the book's mathematics.

Bhattacharya also discusses practical engineering issues, such as device packaging, fiber coupling, reliability and manufacturing processes. He touches upon many new device concepts, including electrically pumped rare-earth-doped semiconductor lasers and wavelength-selective detection schemes. As such, his book is a useful reference for the engineer who is already working in optoelectronics. I feel the book would be very helpful in the design and fabrication of optoelectronic devices. It is an excellent addition to the library of optoelectronic text and reference books.

LILY Y. PANG

*Texas Instruments
Dallas, Texas*

The Physics of Stars

A. C. Phillips

Wiley, New York, 1994.

208 pp. \$59.95 pb

ISBN 0-471-94155-7

The title tells it all: This is a compact and well-organized book about what physics reveals about stars. It is not a treatise for the specialist, however. It is, as it was meant to be, a book

for the advanced undergraduate, and it achieves wonderful success in presenting the physics of approximation, intuition and understanding.

Its strengths are many. Barely is a concept introduced before it is exploited. And with foreshadowing and back-referencing, the important concepts are used repeatedly, so that the reader—student's mastery is assured. When faced with the prospect of the "gray areas" in stellar structure—such as the transitions between degeneracy and nondegeneracy, and between relativistic and nonrelativistic or the boundary conditions on stellar structure—the book keeps the reader focused on the extremes to illustrate the real consequences of the differences in the physics. Don Clayton's wonderful approach to analytic solutions for stellar structure (*Am. J. Phys.* **54**, 354, 1986) is used to explore the structure and properties not only of normal stars but of white dwarfs and neutron stars as well.

Use of the book in an undergraduate course will leave the motivated student with an improved grasp both of the physics and its application to stars. The problems at the end of each chapter are challenging and rewarding (and hints are given at the end of the book). Indeed, anyone who teaches a course on stellar structure ought to read the book for its insights.

But how suitable is it for undergraduates? Very, if they have had some thermodynamics and perhaps are taking some quantum mechanics at the same time. However, unless the sole purpose of the course is to illustrate the application of physics and physical insight, the book will require considerable additional material from the instructor. The book acknowledges some of the most basic observational material, but it pays almost no attention to the particular importance of stellar interiors and stellar evolution in larger contexts. (How do we measure the ages of stars and clusters? How is the light of clusters of stars, or of distant galaxies, affected by star formation and evolution? How can we test nucleosynthesis and stellar evolution models from photospheric abundance analyses? How can we exploit pulsation to test models, opacities and white-dwarf cooling?)

The lack of such material indicates that the book should probably not be the sole text for a course but instead should be supplemented by the instructor and guided readings. It would then help create a very rewarding undergraduate course.

BRUCE W. CARNEY

University of North Carolina, Chapel Hill