

ganized into three parts. The first part establishes a working background by reviewing classical optics, the quantum theory and astrophysics. The second part is the vital portion with its eight chapters containing well over half the text. Its material is a rich collection that treats in considerable detail the developments in optical and electron microscopy, multiple-beam interferometry, luminescence, optical glasses and plastics and fiber optics.

Tolansky is particularly successful in showing how some of these developments have spawned various industrial and commercial applications, which touch on aspects of everyday life, and yet how others have played key roles in fundamental scientific research. In some instances he speaks from firsthand experience and conveys the lively sense of enthusiasm and excitement with which a research scientist attacks a problem. Moreover the debts to the past have not been overlooked and a nice historical perspective has been provided for certain subjects by mentioning the important beginning steps by individuals in earlier centuries. The relatively recent and publicly prominent topics of lasers and holography are taken up in the third part, where concise physical explanations are given and backed by both actual and speculative examples of applications.

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A professor at Trinity College, Robert Lindsay has been teaching undergraduate physics for 13 years.

Singular perturbations

PERTURBATION METHODS IN APPLIED MATHEMATICS. By Julian D. Cole. 260 pp. Blaisdell, Waltham, Mass., 1968. \$9.50

by GEORGE I. BELL

The term "perturbation method" may suggest to most physicists the Rayleigh-Schrödinger theory and related methods of obtaining energy eigenvalues. This book has nothing to do with such perturbation methods, but is rather about problems in singular-perturbation theory, boundary layers and the like.

These problems arise in differential equations containing a small parameter, ϵ , where the solution of the differ-

ential equation for any finite value of ϵ is qualitatively different from the solution for $\epsilon = 0$. Consider, for example, an ordinary differential equation for $x(t)$

$$\epsilon \frac{d^2x}{dt^2} + \frac{dx}{dt} + x = 0$$

For $\epsilon = 0$, the differential equation is first order and $x(t)$ is uniquely determined by $x(0)$; for any finite ϵ , the equation is second order, and both $x(0)$ and $(dx/dt)(0)$ are required to determine the solution that is, in general, qualitatively different from that for $\epsilon = 0$. This book is about solutions to similar and more complicated differential equations using asymptotic expansions in ϵ .

The first half treats ordinary differential equations. Singular-perturbation theory is developed for equations in which ϵ multiplies the highest order derivative, and explanations are provided for matched asymptotic expansions and uniformly valid solutions. Julian Cole also describes methods for treating harmonic oscillators subject to perturbations affecting the period and amplitude, including the "two-time" method. The Van der Pol relaxation oscillator is studied at length. Differential equations with slowly varying coefficients are also examined and contacts are made with adiabatic invariants and the Wentzel-Kramers-Brillouin-Jeffreys method.

In the second half, partial-differential equations (of second order) are considered in which ϵ multiplies the highest-order derivatives. The solutions are examined for elliptic and hyperbolic equations and are applied to a number of hydrodynamic problems, including boundary-layer theory and magnetohydrodynamic pipe flow.

Cole, professor of applied mathematics at California Institute of Technology, is well qualified to write on these topics; he and his colleagues have contributed significantly to the development of these perturbation methods. His book could be read profitably by a graduate student familiar with ordinary and partial-differential equations, but a knowledge of hydrodynamics would help in appreciating some of the examples. Cole employs physical intuition and simple arguments throughout, rather than mathematical rigor, and methods are explained through examples. It could also profit theoretically inclined workers in many fields, for although these perturbation methods have been

largely developed in hydrodynamics, they are applicable in many other fields.

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George Bell, with the theoretical division at Los Alamos Scientific Laboratory, has had an interest in "singular-perturbation theory" since discovering that he had used it (inadvertently) in a transport-theory problem.

Concentration on the nucleus

NUCLEAR PHYSICS: AN INTRODUCTION. By Haro von Buttlar. 547 pp. Academic Press, New York, 1968. \$14.50

by NORMAN A. BAILY

I examined this book from the point of view of using it as a text for the first quarter of an advanced radiation-dosimetry course. What was desired was a comprehensive review of nuclear-physics fundamentals to serve as a base in developing the specialized topics of the course.

The book provides excellent coverage of many topics and treats neutron interactions extensively, but gives very little coverage to charged-particle interactions or the interactions of photons with matter. Rather than the usual broad topical spread found in many texts with similar titles, the book concentrates, and probably rightly so, on the nucleus. It should, therefore, adequately prepare the physics undergraduate student for more advanced treatments of the same topics, in addition to providing the groundwork for advanced concepts not treated.

The approach is quite sound, starting with a review of collision theory and the central-force problem. Part A continues with such subjects as nuclear-binding energies, kinematics and decays. The liquid-drop model is described together with its limitations, and neutron physics concludes this section. Part B introduces the student to applicable quantum-mechanical concepts, and the third section then treats selected topics, which are nuclear spin, nuclear moments, the shell model, the two-nucleon problem, reaction cross sections, alpha- and beta-decay theory, and summaries of the various nuclear models.

Haro Von Buttlar is a professor at the Institut Für Experimentalphysik, Ruhr-Universität Bochum, Germany. He wrote this text to bridge the gap