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Book Reviews

Mathematics for the Physical Sciences. By HERBERT S. WILF. Wiley, New York, 1962, 284 pp. $7.95.

Professor Wilf has written a small and valuable book. This 280-page volume is not a text on mathematical physics, and its study will not transform a callow graduate student into a confident "theoretiker." Rather, it presents material drawn from several fields of mathematics, special topics of particular importance to the growing student, and to those who practice mathematical physics "in the modern manner."

The book has seven chapters, entitled "Vector Spaces and Matrices," "Orthogonal Functions," "The Roots of Polynomial Equations," "Asymptotic Expansions," "Ordinary Differential Equations," "Conformal Mapping," and "Extremum Problems." Thus, the student of physics will have to learn about the differential equations of Laplace and Helmholtz, the theories of residues and integral transforms, vector and tensor algebra, etc. from other sources. Each chapter is graced by an annotated bibliography, which encourages the reader to browse in the mathematical literature, and by exercises whose solutions are also given.

Professor Wilf's style of writing is specially fine. It is very clear and manages to be serious and somewhat informal at the same time. While his material is presented as theorem, proof, theorem, proof, . . . the reader has the feeling that epsilonics are being held to a minimum. Almost always, the *idea* of the theorem is stressed, and is summarized, along with the proof.

The material in the chapters is not a restatement of the "same old stuff." Professor Wilf has a special interest in the use of digital computers in mathematics, which is reflected in his choice of topics. In the first chapter, after going through the usual preliminaries, he presents some interesting material on the numerical calculation of eigenvalues and on the properties of matrices with nonnegative elements, those operators so dear to reactor group-theoretikers. The chapter on orthogonal polynomials contains a discussion of Gauss quadrature and introduces the Jacobi matrix, while later chapters include sections on numerical methods for finding roots of polynomial equations, for solving differential equations, and on the construction of algorithms for the solution of extremum problems. Of course, these are not "how to" sections, but rigorous discussions of the numerical methods, which enter naturally into the development of the topic. The author's concern with "understanding before computing" leads him to make a fine sentence, which will be treasured by all members of the society for the Prevention of Computational Outrage. It is that "The blind use of computing machinery (in such cases) can lead only to chaos."

Since the book is short, it is easy for the reader to find topics that should have been included—in his opinion. A short discussion of the zeros of analytic functions other than polynomials would have been most welcome, since one encounters transcendental equations often enough in applied mathematics. Also, the sections on differential equations in the complex plane should be augmented by a short discussion of singularities at infinity. (The corresponding chapter in "Whittaker and Watson" is a model of brevity and clarity.) On the other hand, Wilf's chapters on orthogonal functions and asymptotic series are unusually good, and there is, over-all, a fresh presentation of the subject matter.

One can warmly recommend "Mathematics for the Physical Sciences." Its content and manner of printing make reading it a pleasure. No doubt, also, the price is right.

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(About the Reviewer: Noel Corngold was educated at Columbia College and Harvard University, where he received the Ph.D. degree in physics in 1954. He works at mathematical physics as group leader in theoretical reactor physics at Brookhaven National Laboratory.)

The Theory of Plasma Waves. By T. H. STIX. McGraw-Hill, New York, 1962.

"The literature on plasma waves and instabilities has grown to an impressive size in the last decade, and continues to grow at a frightening rate," to quote the author. The same cannot be said of texts covering this particular subject, so vital to controlled fusion research. The absence of any previous text with a general treatment of this topic would be reason enough to welcome this book. There is even more reason to rejoice in the fact that Dr. Stix's book provides an excellent, well-organized, thorough, and highly-competent treatment of the subject.

The central theme of the book is the linearized Vlasov (or collisionless Boltzmann) equation. This is the basic equation governing the motion of fully ionized hot plasmas, which have now become available experimentally in the controlled fusion program here on earth and have always been available in extraterrestrial situations. The equation may also be applied, with rather simple corrections, to the ionosphere.

The Vlasov equation may be simple, but the range of possible modes of oscillation of a plasma it allows is bewilderingly complex, especially when one immerses the plasma in external magnetic and electric fields and considers streaming of electron or ion beams through the plasma. The author carefully unravels the confusion by proceeding from the simple to the complex. The initial chapter contains a general discussion of waves, introducing the concept of the wave-normal surface and the bounding surface in parameter space. The dielectric tensor is defined and evaluated in the