REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the indexing system printed in Volume 28, Number 128, October 1974, pages 1191–1194.

6 [2, 3, 4].—HANS J. STETTER, *Numerik für Informatiker – Computergerechte numerische Verfahren. Eine Einführung,* R. Oldenbourg Verlag, München, Wien, 1976, 149 pp., 24 cm. Price DM 19.80.

This is an introductory text on numerical methods addressed to students in computer science whose main interests lie outside the area of numerical computation. The author, therefore, makes a deliberate attempt to bring into focus the interfaces that exist between computer science and numerical analysis. The result is most noticeable in the three introductory chapters dealing with computer arithmetic, various sources of errors and error propagation, as well as in the concluding chapter on principles of numerical software development. The exposition, throughout, is concise and clear. Proofs are given only if they enhance the understanding of the subject. One year of calculus and some familiarity with the elements of linear algebra ought to be sufficient background for a profitable study of this booklet.

The chapter headings are as follows: 1. Introduction, 2. Computer arithmetic, 3. Error propagation, 4. Evaluation of functions, 5. Solution of equations, 6. Linear systems of equations, 7. Specification of functions through data, 8. Numerical integration and differentiation, 9. Ordinary differential equations, 10. Numerical software. Each chapter is followed by exercises, some of which involve projects to be carried out on the computer. Unfortunately, there is no index of any kind.

W. G.

7 [3.00, 4.00].—MARTIN GUTKNECHT, PETER HENRICI, PETER LÄUCHLI & HANS-RUDOLF SCHWARZ, *Heinz Rutishauser*: *Vorlesungen über numerische Mathematik,* Vols. 1 and 2, Birkhauser Verlag, Basel, 1976, 164 pp. and 228 pp. Price Vol. 1 Fr./DM 40; Vol. 2 Fr./DM 48.

When Heinz Rutishauser, a pioneer of computational mathematics, died at the age of 52 in 1970, he left updated notes of his lectures on Numerical Mathematics which he had intended to convert into a text book. With the aid of P. Henrici, P. Läuchli, and H. R. Schwarz, M. Gutknecht has managed to edit this material into two volumes which are strikingly uniform in form and style.

Those who have taught introductory courses in Numerical Mathematics will be delighted at first sight: numerous instructive examples and illustrations enhance a clearly and suggestively written text. There is the fine balance between mathematical and computational reasoning which is so essential, and the limitations of both aspects are exposed.

The first volume covers linear equations and inequalities, with special attention to positive-definite systems, nonlinear equations, optimization, interpolation, quadrature and approximation. Although most of the material is standard, the approach and the argumentation are often original; also the level of an introduction is maintained through out without loss of understanding. Surprisingly, "condition" is not introduced as a concept although it is at the basis of many discussions.

The second volume is devoted to differential equations and eigenvalue problems. The treatment of ordinary initial value problems stresses the numerical mechanisms and even explains expontial fitting; that of ordinary boundary value problems includes shooting (called "artillery method"), differences and discrete variational methods. An exposition of the numerics of elliptic partial differential equations leads to iterative methods for linear systems (including conjugate gradients); norms and condition numbers of matrices appear at this late stage. An economic coding of the associated sparse matrices is suggested. In connection with heat conduction problems there is an interesting analysis of the feasibility of a systematic increase of the time step due to the elimination of high frequency error components. A short discussion of the one-dimensional wave equation completes the numerical analysis of differential equations. In just the same fashion, the section on eigenvalue problems guides the student to an understanding of the essential numerical aspects and methods without confusing him by unnecessary technicalities. Even the treatment of the shifts in the *LR*-method remains transparent and immediately convincing.

A most interesting appendix "An axiomatic basis for numerical computing and its application to the *QD*-algorithm" concludes the book. Rutishauser's approach is not to introduce intricate algebraic structures but simply to formulate as axioms those properties of common computer arithmetic which are necessary for a rigorous analysis of algorithm on a digital computer. The feasibility of his approach is shown by the proof of theorems on the performance of the *QD*-algorithm which has been introduced in the first part of the appendix. (The manuscript of this appendix was not completed when the author died.)

It is hoped that this book will see widespread use by the students for whom it has been intended and for whom it would furnish an exquisite introduction into the subject. In any case, the editors have set a worthy memorial to their friend H. Rutishauser.

H. J. S.

8[4.10.4, 5.10.3, 5.20.4].—J. T. ODEN & J. N. REDDY, *An Introduction to the Mathematical Theory of Finite Elements,* Wiley, New York, 1976, xii + 429 pp. Price $21.95.

This book is devoted to the mathematical foundations of the Finite Element Method (F E.M.) and its application to the approximation of elliptic boundary value problems and time dependent partial differential equations.

Let us first describe briefly the content of each chapter: Chapter 1 is an introduction in which we find a brief history of the F.E.M., an outline of the following chapters and, finally, some of the mathematical notation to be used in the remaining part of the book.

The following eight chapters could be divided into two parts. Part I (Chapters 2, 3, 4, 5) contains the mathematical background for, and Part II (Chapters 6, 7, 8, 9) the theory of, the F.E.M. Each chapter has its own bibliography.

In Chapter 2 the authors define distributions on a domain Ω of $\mathbf{R}$, their derivatives, the convergence of a sequence of distributions, etc.; all these definitions are illustrated by various examples. Also distributional differential equations and the concept of fundamental solutions are briefly considered.

Chapter 3 is related to the theory of Sobolev spaces. Once the definition of such spaces has been given, the authors, following Sobolev [1], prove several properties of the Sobolev spaces, in particular various embedding theorems, when Ω has the so-called cone property.

In Chapter 4 the authors use the approach of Lions and Magenes [2] to define the the Sobolev spaces $H^s(\mathbf{R}^N)$, first for $s \in \mathbf{R}_+$, and then for $s < 0$; this approach which is now classical is based on the use of the Fourier transform. Then the authors prove a trace theorem for the functions of $H^m(\mathbf{R}^N_+)$ ($\mathbf{R}^N_+ = \{x \in \mathbf{R}^N \mid x = (x_1, x_2, \ldots, x_N), x_N > 0\}$) and study various properties of the trace operators (continuity, surjectivity,