specialized graduate course. While topical, the author has pointed out many interconnections and underlying principles. In surveying broadly important aspects of a growing field in numerical analysis, this volume (a considerable revision of lecture notes by the author from 1975) is a most welcome addition to the library of numerical analysts and applied mathematicians.

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1. E. P. DOOLAN, J. J. H. MILLER & W. H. A. SCHILDERS, *Uniform Numerical Methods for Problems with Initial and Boundary Layers*, Boole Press, Dublin, 1980.

2. P. W. HEMKER, *A Numerical Study of Stiff Two-Point Boundary Problems*, Math. Centre Tracts 80, Amsterdam, 1977.

16[65P05].—LEON LAPIDUS & GEORGE F. PINDER, *Numerical Solution of Partial Differential Equations in Science and Engineering*, Wiley, New York, 1982, 677 pp., 24 cm. Price $44.95.

This volume considers virtually all numerical methods for solving partial differential equations known and widely used in the late seventies. Written as a textbook for a course, it includes hardly any proofs but devotes its considerable number of pages to lucid developments of the methods, often starting with simple examples and building upwards.

The Chapters are as follows:

Ch. 1. Fundamental Concepts (in partial differential equations).

Ch. 2. Basic Concepts in the Finite Difference and Finite Element Methods.

Ch. 3. Finite Elements on Irregular Subspaces.

Ch. 4. Parabolic Partial Differential Equations.

Ch. 5. Elliptic Partial Differential Equations.

Ch. 6. Hyperbolic Partial Differential Equations.

The basics of finite difference and finite element methods (Galerkin, collocation, boundary elements) are treated in each context where it applies. Fast methods for solving relevant linear systems of equations are given thorough consideration: these methods include odd-even reduction, point and line iterative methods (Jacobi, Gauss-Seidel, successive overrelaxation...) and also alternating direction and locally one-dimensional methods.

Certain modern developments are not treated, thus somewhat dating the book and making it less useful as a reference. (The inside cover flap states that the book is aimed to be a reference/textbook, whereas the preface makes no claim that it is a reference book.) These topics include many "fast" methods recently in vogue such as: Spectral methods, node reordering schemes, conformal mapping techniques, random choice methods, multigrid techniques (except classical extrapolation schemes), capacitance matrix techniques, and use of fast methods as preconditioners in iterative schemes. Also, mixed methods are treated very briefly.

Generally, pitfalls are clearly pointed out; as omissions I noted that hardly anything is said about the need for one-to-one mappings in isoparametric elements or about problems with corner singularities in elliptic problems (although sources and sinks are briefly considered).

The only really objectionable statement I found occurs on p. 242 (and recurs on p. 246). It is stated that the problem with implicit finite difference methods in parabolic problems in two space dimensions is that the resulting linear system of equations to solve involves a penta-diagonal matrix, and thus the effective tri-diagonal solver cannot be applied. Of course, there are very effective penta-diagonal solvers, but the matrix is not penta-diagonal.

Given that the book aims for a first course covering "The Classics", the treatment is excellent from a pedagogical point of view. The student is slowly and carefully led towards a thorough understanding of the methods.

Finally, the writing is very polished and I found it a pleasure to read!

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17[65L00, 65M00, 65N00].—JAMES M. ORTEGA & WILLIAM G. POOLE, JR., *An Introduction to Numerical Methods for Differential Equations*, Pitman, Boston, Mass., 1981, ix + 329 pp., 24 cm. Price $24.95.

Although the title of this book is a correct description of its content, it may be a bit misleading. This is really an introductory textbook on Numerical Methods, and it is distinct from other such books mainly by its arrangement of the material; linear equations, e.g., are treated as the predominant part of a chapter on boundary value problems for o.d.e., numerical quadrature is presented as a tool in the context of projection methods, etc. While thus the constructive solution of differential equations (including p.d.e.) serves as the frame of reference, the treatment of the classical material within this frame is just as broad and detailed as is usual for a first introduction to Numerical Mathematics. It is difficult to tell whether this arrangement will be more appealing to students; in any case it permits the use of demonstrative application examples in differential equations throughout the book.

Generally, the authors have avoided formulating and proving theorems; they state many results in a semiformal way and rather provide motivations and explanations. However, the presentation is sufficiently technical and concise that more formal results and proofs may easily be added here and there by a more ambitious instructor; references, supplementary remarks, and a set of well-chosen exercises help the reader to gain a deeper understanding if he wishes. On the other hand, the text may disappoint those who are looking for an easy access to the practical use of numerical methods (say science or engineering students); they will feel diverted by the many mathematically minded discussions and will miss concrete guidelines for the use of relevant library programs.

The introductory chapter on "the world of scientific computing" which includes a discussion of symbolic computation starts the text off nicely, and there are a few chapters which are exemplary in their short and clear presentation of essential aspects. The sections on eigenvalue problems, on sparse linear equations, and on projection methods I found particularly well-composed. Also I liked a number of details (like the "interval of uncertainty" about a zero of a function) and many of