REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1980 Mathematics Subject Classification can be found in the December index volumes of Mathematical Reviews.

11[65-01, 65L05, 65P05].—JOEL H. FERZIGER, *Numerical Methods for Engineering Application*, Wiley, New York, Chichester, Brisbane and Toronto, 1981, xii + 270 pp., 24 cm. Price $29.95.

This book is a compendium of numerical methods for differential equations which is intended as a reference for practicing engineers and as a text for engineering students. The style is informal throughout—no theorems or proofs.

There are four chapters in the book. The first two are very brief introductions to interpolation and quadrature. The bulk of the text (202 pages) is devoted to ordinary and partial differential equations. The approach used by the author is to state a method and illustrate it by showing the output (tabular or graphical) of a corresponding program applied to some problems. There is little in the way of guidelines for the use of library routines.

The text contains 46 exercises, two appendices, an index, and a short annotated bibliography to the textbook literature.

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12[65N30, 65N50].—GRAHAM F. CAREY & J. TINSLEY ODEN, *Finite Elements, Computational Aspects*, Vol. III, Prentice-Hall, Englewood Cliffs, N. J., 1984, x + 350 pp., $23\frac{1}{2}$cm. Price $35.95.

To quote the authors "our purpose... (is) to develop certain computational aspects of the (Finite Element) Methods to a greater extent". As such, this book can be considered as the practical companion to their Volume I. Programs given in Volume I are detailed here. A first chapter recalls rapidly the main aspects of a computer simulation by the Finite Element Method (FEM). This chapter relies heavily on knowledge of Volume I or some introductory course on FEM. Next, the authors in a very long chapter deal with the central question of FEM meshes. First they cover briefly the question of mesh generation and go on to the more advanced subject of mesh refinement, including boundary layers and use of a posteriori estimates for automatic mesh refinement in one-dimensional problems. The more delicate question of 2D automatic mesh refinement is treated in a long subsection; examples are given from the ambitious work of Babuška and his collaborators.

0025-5718/85 $1.00 + $.25 per page

Refinement and iteration methods such as multigrids are also considered. Extensions include a short survey of hierarchic (p-methods) elements; error estimates are recalled but practical implementation of such a method is left as an exercise, although it is not yet a very familiar one.

The next chapter, written by A. Sherman, deals with the solution of sparse systems of linear equations. Methods for positive definite systems are given first: sparse methods (symbolic factorization, band and envelope methods) and their related optimization problems (band reduction, nested dissection, minimum-degree ordering). Next, iterative methods are recalled (conjugate gradient with preconditioning). This is followed by a section on "out of core" implementations of symmetric Gaussian elimination (band and frontal methods). Finally, general nonsingular systems are briefly considered.

The next chapter is about eigenvalue problems. The principal iterative methods considered are the subspace iteration method and the Lanczos method. Givens' and Householder's reductions are also given. Methods are described mainly in the case of the classical eigenvalue problem, but a short section recalls how to extend these methods to the generalized eigenvalue problem. Error estimates and applications of eigenvalue/eigenvector computations are given: mainly modal superposition and matrix conditioning.

Chapter 5 introduces time-dependent problems. Parabolic semidiscretization (forward, central and backward difference) is studied by means of eigenexpansions. Second-order (wave) equations are very briefly considered. More details are given for convection diffusion type problems. Splitting methods, including ADI, are recalled and there is a brief analysis of stability and errors. Mention is made of moving mesh methods.

The book includes more than 170 references and an appendix on interpolation and quadrature. If we except the first chapter, the book is actually quite self-contained. It is well written and pleasantly presented, with numerous examples. It will be of help for both researchers and students in need of implementing or understanding actual coding of the FEM. The only serious shortcoming is that the most useful algorithms for second-order (wave) problems are not given; maybe the authors are planning to include that in their volume on solid mechanics.

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13[65N30].—Vidar Thomée, *Galerkin Finite Element Methods for Parabolic Problems*, Lecture Notes in Mathematics 1054, Springer-Verlag, Berlin, 1984, v + 235 pp., 24 cm. Price \$11.00.

From the author's preface:

"The purpose of this work is to present, in an essentially self-contained form, a survey of the mathematics of Galerkin finite element methods as applied to parabolic problems. The selection of topics is not meant to be exhaustive, but rather reflects the author's involvement in the field over the past ten years. The goal has