BOOK REVIEWS

Numerical Recipes: The Art of Scientific Computing

William H. Press, Brian P. Flanner, Saul A. Teukolsky, William T. Vetterling, Cambridge University Press, 1986, 818 pp. $39.50; Example Book (in Fortran or Pascal), $18.95

This superb book covers many topics, explains the theory, and provides computer programs to apply the theory. The programs (in Fortran or Pascal) are available on microcomputer diskettes. The book is useful not only for its information on a variety of topics but for the programs themselves.

The topics include linear algebra, interpolation and evaluation of functions, sorting algorithms, root finding and minimization, eigensystems, Fourier methods (including Fast Fourier Transforms), statistical analysis of data, integration of ordinary differential equations as initial value problems or as boundary value problems, and partial differential equations. Some of these subjects are in my own area of expertise and I can evaluate the treatment as an expert; others are in subjects I've not worked in, and which I evaluate as a novice. It gets good marks on both scores.

Because the book covers so many topics, the treatment of each topic is somewhat limited. For integration of initial value problems that are ordinary differential equations, the reader is given Runge-Kutta methods with an adaptive mesh selection, Richardson extrapolation, and how to treat singularities. The book does not cover stiff methods in detail, but does refer to other literature. For boundary value problems, shooting methods or finite difference methods are presented: however, the iterative strategy for the shooting methods is not sophisticated and the automatic mesh placement for the finite difference method is *ad hoc* which does not control the error. These limitations are carried over to the treatment of partial differential equations, where finite element methods are relegated to a few references. However, in the format of the book, "I have a problem, how do I solve it?", this is understandable. Someone wanting only to solve one problem should probably steer clear of the finite element method with its greater demands on programming effort. For hyperbolic methods, those included are the leap frog and Lax-Wendroff methods. Newer and better methods (such as random choice and flux-corrected transport) are not mentioned. The chosen methods do work, however, as long as the oscillations do not bother you. For elliptic problems, Laplace's equation and iterative finite difference methods are focused on.

Throughout the book each subject begins with a clear description of the key theory, some practical tips, and the computer programs. It also contains such useful tips as what is "small," or how the adjustable or tuning parameters of a method are chosen. It explains why a certain strategy was used first in approaching a problem. The computer programs are easy to read, and a modified format is used to clarify the nesting of loops. The style of writing is friendly and conversational: for example, "Until you have enough experience to make your own judgment between the two methods, you might wish to follow the advice of your authors as notorious computer gunslingers: We always shoot first, and only then relax."

The book explains the programs fully (in Fortran). The example book gives examples of using the programs and subroutines. Four diskettes (IBM-compatible) offer machine-readable versions of all the programs and the example programs: two are in Pascal and the other two are in Fortran, each set with the examples and the programs. The programs are adaptable to any minicomputer or microcomputer. Overall, this is a valuable reference book, whose computer programs are available in machine-readable format on microcomputer diskettes.

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Avoiding and Managing Environmental Damage from Major Industrial Accidents

Air Pollution Control Association, 498 pp., 1985

This book contains the proceedings of the 1985 international conference of the same name sponsored by the APCA in cooperation with a number of international associations, universities, and governmental agencies.

Twenty-nine papers in this book are divided into six major categories: case histories; financial and legal implications of major industrial accidents; prevention; contingency planning; perceptions by society and their impact on the management of hazardous materials; and international policy initiatives. The executive summaries of these six sessions, which were prepared during the conference by the session rapporteurs, are most useful.

Discussed in the first section are the case histories of three controversial accidents: the accident at the Union Carbide plant at Bhopal, India; the nuclear power plant accident at Three Mile Island, PA; and the train derailment at Mississauga, Ontario, Canada resulting in a propane fire, explosion and a chlorine release. All three case histories graphically demonstrate the need and benefit of advanced planning, preparedness, and public awareness.

The second section's four papers covered the following topics: experience in the application of hazard assessment on World Bank industrial projects; evolving trends in environmental audits; risk assessment for environmental liability insurance in both Europe and North America; and evolving trends in legal liability. The consensus was that industry must be proactive in its management of environmental risks for its future economic viability.

Section 3 on Prevention has five papers covering process and design decisions, siting and zoning issues, risk analysis techniques, management philosophy/training and skills development, and the audit process. The paper on risk analysis techniques is limited in that it deals primarily with the fault tree approach. Interestingly, one paper that discusses Dow Chemical's philosophy and experience in emergency incident management places emphasis on prevention rather than on reaction.

Three papers discuss contingency planning in Section 4. They review elements of effective contingency planning, development, and commitment to contingency planning, and criteria to assess integrated communications plans for emergency response.

Section 5 contains six papers on perceptions by society and their impact on the management of hazardous materials operations. They discuss how information about risk is communicated to the public in the U.S. and Europe and how important public perception is.

In the last section, international policy initiatives are reviewed by speakers from the United Nations Environment Program (North America), the U.S. EPA, Environment Canada (Canadian Government), Korean Government, European Economic Community, Chemical Manufacturers Association, and the World Health Organization.

The collection of papers in this book are interesting in that they emphasize the need for managers in government, industry, insurance and legal firms, public relations groups, and news media to obtain a better understanding of the complex problems encountered in the prevention and management of accidental releases of hazardous chemicals.

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Membrane Separations in Biotechnology (Bioprocess Technology Series, Volume 1)

By W. Courtney McGregor, Ed., Marcel Dekker, Inc., 408 pp., 1986, $65.00

This volume is a quite useful and readable reference text for the practicing biomedical, biochemical or bioprocess engineer seeking guidance about the suitability of membrane processes for the separation, purification and isolation of biologically-derived products. The treatment of the subject is largely descriptive; the presentation is long on experimental data and anecdotal observations, and short on data analysis and interpretation. This book should be useful for someone who is not particularly knowledgeable in the membrane separations art, but wants to know how useful a membrane process might be for a particular bioseparation and which membranes and systems should be considered in light of their benefits and problems.

The opening chapter (authored by McGregor) is a particularly helpful compendium of the properties and operating characteristics of commercially available ultrafiltration membranes. This is followed by a somewhat circumscribed treatment (coauthored by Sirkar and Prasad) of the polarization/fouling of ultrafiltration membranes by proteins, which, while of scientific merit, might be more appropriate as a learned journal article than as a chapter in this volume.

The succeeding 11 chapters deal with specific membrane process applications, and are replete with operating data, process flow diagrams, good descriptive text, and readable graphics. Each concludes with an extensive and reasonably current bibliography. The process that receives major attention is ultrafiltration, with applications to cell harvesting, antibiotic recovery, affinity purification, blood plasma fractionation, and food processing. There are chapters that individually address the following subjects: electrodialysis (for blood plasma processing); pervaporation/gas permeation (for fermentation alcohol recovery); reverse osmosis (for waste water treatment); and mainly dialysis (for artificial kidney). The chapter on food processing discusses both ultrafiltration and reverse osmosis applications. Two chapters deal with membrane-based bioreactors (immobilized enzyme-, immobilized plant/animal cell-, and immobilized microbial devices). The contributing authors are recognized experts and practitioners in their areas, who are well qualified to present balanced views of their subjects.

As is true of any multiauthored text covering a wide range of specific topics, however, there has been little attempt to cross-reference among chapters or to make comparative evaluations of alternative methods for accomplishing particular separations. Thus, the book is essentially a compendium of monographs, each capable of standing alone. This, however, does not detract from its value as an information source.

One feature of the editorial layout is somewhat distracting: because the figure and table captions are printed in the same font and type size as the text, it is difficult to find where the text begins on a page. Different or bold type face for captions would have avoided this problem.

All factors considered, I regard this book as a useful addition to the chemical engineering literature and recommend its acquisition by both industrial and academic engineering libraries.

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Relaxation in Glass and Composites

By G. W. Sherer, John Wiley & Sons, 1986, 331 pp.

This interesting and timely book focuses on the generation of residual stresses caused by relaxation effects in glasses that occur during manufacturing operations. The approach taken gives a reasonable balance between theoretical developments and applications. Practical assessments based on available data are woven in throughout the treatment. At critical junctures, the balance is usually struck in favor of empirical forms if the theory is found lacking, yet where appropriate the theory is amply developed. The organization of the material begins with simple, background formalisms and is built up logically to the full complexity of the topic. Overall, the book is a thorough formulation resulting in the best current single source for information on the topic.

In terms of specific assessments, however, terminology could have been clarified better, and its reference to composites in the title is misleading. The overwhelming current use of the term composites is with reference to fiber-reinforced composite materials. The treatment in the book is of no relevance to that field, rather it concerns the behavior of multimaterial structures such as sandwich forms. The last third of the book concerns application examples that represent variations of what is called the sandwich seal. This form refers to a multimaterial laminate where some layers behave perfectly elastically, but the temperature-induced relaxation in the glass layers leads to residual stresses in both materials, which can be design-limiting. The variations in this planar form simply involve extensions to cylindrical and spherical coordinates.

The key to the theoretical treatment is in the use of the concept of thermorheologically simple behavior, whereby the temperature dependence of relaxation functions can be incorporated through the well known shifting procedure. In this sense, the approach is very similar to that in polymer science. It is a happy circumstance that both fields agree on this extraordinarily unifying method of characterizing material behavior. This book demonstrates reasonable validation of the shifting procedure for oxide glasses. The treatment appropriately distinguishes between the time dependence induced by