

Books

Mass Transport in Solids and Fluids

David S. Wilkinson, Cambridge University Press, New York, 270 pp., \$110, 2000

This textbook provides principles of matter transport and their application to a range of materials science and engineering problems. The author presents a unified phenomenological treatment of mass transport applicable to both solids and fluids, with an emphasis on diffusion in solids. The usually adopted treatment of diffusion processes in the fluid phase is different from that in solids. The unified approach used in this textbook allows the student to make a clear connection between diffusion transport in these two fields.

Students are assumed to have knowledge of thermodynamics, including use of binary phase diagrams, as well as of partial differential equations. The textbook includes ten chapters, containing numerous worked examples, which are subdivided into four parts and five appendices. These include: Part A: overview (Chapter 1); Part B: solid-state diffusion in dilute alloys (Chapters 2–6); Part C: mass transport in concentrated alloys and fluids (Chapters 7–9); and Part D: alternative driving forces for diffusion (Chapter 10). At the end of each chapter, guidelines are given for further reading and problems are presented. Appendix A deals with solution methods for the diffusion equation, which one would expect to be more extended. Appendices B through E present useful diffusion data, and binary and pseudo-binary diagrams.

This book is aimed at students of materials science, engineering and related disciplines, such as metallurgy and ceramics. The book is suitable for advanced undergraduate and beginning graduate students, and can be covered in a one-semester course.

Victor M. Starov

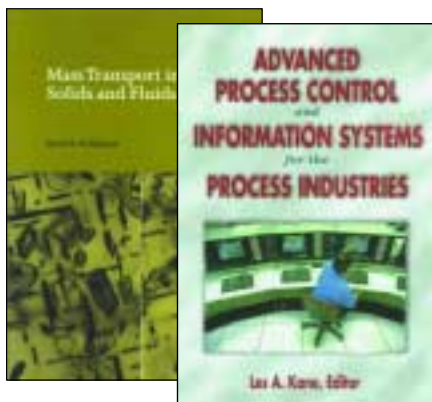
V. M. Starov is a professor of chemical engineering at Loughborough Univ., Loughborough, U.K.

Attributes of the Unified Field and Quantum Gravity: On Defining the Hubble Constant

Jonathan Oswald Brooks

Vantage Press, New York, 119 pp., \$24.95, 2000

This collection of papers represents over 20 years of cumulative work in developing the concept of quantum attribute theory. This theory is an attempt to incorporate the concept of quantum gravity into equations to provide additional tools for examining traditional relativity and quantum mechanics. His quantum attribute theory attempts to define and predict both



cosmological and sub-nuclear behaviors.

The next big discovery awaiting physicists, and ultimately humankind, is to formulate a workable theory of everything. Attaining an understanding of how quantum mechanics and general relativity reconcile is central to this goal. Brooks' controversial theory using unified field, quantum gravity, spin, and an ideal cosmology from which a constant Hubble value is defined is based upon his radial solution to the Schroedinger equation.

The text provides thorough references to the foundations upon which Brooks' theory is based and exhibits equations, data tables and graphs to support his work. A renewed interest in superstring theory — an attempt to connect general relativity and quantum mechanics based upon so-called strings vibrating in ten dimensions — is gaining momentum among interested scientists. Brooks proposes that his quantum attribute theory can provide a simpler approach to the problem. Providing a first-hand look at the nuts and bolts involved in theoretical development, the book addresses the most exciting question in modern physics.

Robert Walter

R. Walter is president of AntiEntropics Inc., New Market, MD.

Advanced Process Control and Information Systems for the Process Industries

Edited by Les A. Kane, Gulf Publishing, Houston, TX, 336 pp., \$75, 1999

The chapters in this book are based on articles first appearing in *Hydrocarbon Processing*. The editor's stated goal is "to provide process control, instrumentation, process and information system engineers and managers with a practical guide to improving process control and information systems in the process industries." The areas covered include project justification and implementation, model-based control, online optimization, plant information systems, and front-line control.

The articles are well written, and all but one or two provide bibliographies. Several of the 56 articles are redundant, although in some cases it is useful to see how different authors treat the same subject. Although original publication dates are not given, the articles appear to be more than five years old. The book is a good introduction for anyone working in a processing facility who may be unfamiliar with the topics covered.

James Crocker

J. Crocker, P.E., is president of Cogema Engineering Corp., Richland, WA.

Development and Application of Computer Techniques to Environmental Studies VIII

Edited by G. Ibarra-Berastegi, C. A. Brebbia, P. Zanetti, WIT Press, Southampton, U.K., 560 pp., \$259, 2000

This book provides an account of various studies on environmental aspects; it contains 52 articles from the eighth international conference on the development and application of computer techniques to environmental studies, ENVIROSOFT 2000, organized in Bilbao, Spain, July 28–30, 2000. The volume is divided into ten sections: air pollution; water and soil pollution; mathematical modeling; environmental sciences and engineering; meteorology and climatology; surface and groundwater hydrology; environmental management and decision analysis; databases, satellite data, image processing and remote sensing; and software models. The authors give both a theoretical and practical overview of the aforementioned domains.

Included is a keynote address that discussed using an Internet review for environmental data. Existing web sites and databases for simulation models, articles, technical reports and statistics are also included.

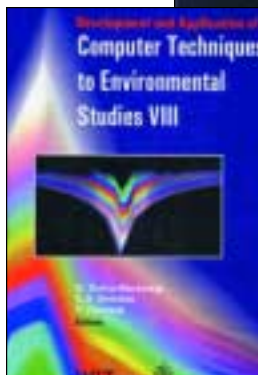
The first chapter deals with modeling of air pollution and computational applications to simulate and forecast the air quality. Surface and groundwater hydrology and the connection to soil pollution are covered in later chapters. There is a discussion of forecasting water quality using an artificial neural network. The fifth section of the book concerns meteorology and climatology modeling, with the applications to El Niño, the atmospheric water vapor cycle, climate analysis and solar radiation.

The last four chapters are on waste management by planning and modeling, databases for the Adriatic Sea and a test reference year of global solar radiation. The authors present theoretical background and provide specific applications. Interfacing environmental models through the worldwide web are also included. The environmental improvements in the last 30 years have been enormous, at least for industrial pollution, but the growth of transportation emissions is creating new problems and challenges. There is now a greater awareness of global issues and dangers, such as the possibility of future global changes caused by anthropogenic activities.

Never before have environmental and computer science been so vital. The language of all the articles of the book is quite clear and, although technical, it is easily understandable.

Ioana Ionel

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Advanced Mathematical Methods in Science and Engineering

**S. I. Hayek
Marcel Dekker, New York, 734 pp., \$195, 2001**

Aimed at advanced level students, this book assumes knowledge of differential and integral calculus and introductory-level ordinary differential equations. It presents methods of applied mathematics suited for the application to physical problems in science and engineering. The book contains illustrated examples and many problems with solutions to almost all of them. Hayek's book is divided into nine chapters and five appendices.

The first chapter deals with ordinary differential equations (ODEs) and covers linear ODEs, Euler's equation, particular solutions to ODEs, Abel's Wronskian formula and initial value problems. Chapter Two looks at the series solution of ODEs and includes power series solutions, classification of singularities and Frobenius's the solution. Chapter Three is dedicated to special functions such as Bessel, modified Bessel, Hankel and Legendre types and their respective variations, such as order zero and half-order Bessel functions, and integrals of Legendre polynomials. Chapter Four includes boundary-value and eigenvalue problems. Vibration, wave propagation, torsional vibration, Fourier series and Sturm-Liouville systems are featured. Chapter Five deals with complex variable functions such as Cauchy's integral theorem, infinite series, Taylor's expansion theorem, Laurent's series, and the residue theorem. Chapter Six covers partial differential equations in mathematical physics and engineering. Chapter Seven looks at integral transforms, and covers the Fourier integral theorem and transforms, Hankel transforms, Laplace transforms, Mellin transforms and solution of ODEs and PDEs by Laplace transforms. Chapter Eight is dedicated to Green's functions, containing 35 sections involving Green's identities for different operators, casual fundamental solution for the diffusion and wave operators, and casual functions for wave and diffusion operators in bounded media. Chapter Nine covers various asymptotic methods for evaluating integrals and solving ODEs.

Appendices A through E cover infinite series, orthogonal co-ordinate systems, Dirac delta functions and plots of special (Bessel) functions, respectively.

The typesetting of equations should be more consistent in relation to the relative sizes of symbols; otherwise the book is an indispensable and comprehensive source of information for students, instructors and practitioners.

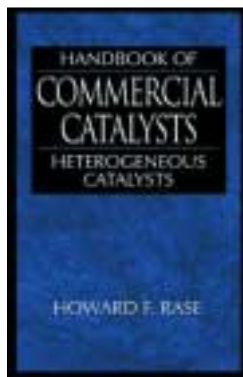
Haitham Yousef

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Handbook of Commercial Catalysts: Heterogeneous Catalysts

Howard F. Rase

CRC Press, Boca Raton, FL, 520 pp., \$139.95, 2000



According to the author, “this handbook is written for chemical engineers and chemists involved in selecting or improving an existing process.” It contains detailed descriptive information on 150 major industrial processes using heterogeneous catalysts, organized by class of reaction, starting with acetoxylation and alkylation. For each reaction presented, information is promised on product uses, chemistry, mechanism, catalyst type, catalyst suppliers and licensors, catalyst deactivation, catalyst regeneration, description of process units and process kinetics.

The book contains much more breadth of information than promised by the title, but perhaps less information on the catalysts themselves than might be expected. The coverage of the processes and catalysts seems uneven, with a high level of detail on some and sparse information on others.

The section on product uses for each particular product is simple, but adequate as a first introduction. The presentation of reaction mechanism is usually quite detailed, and, apparently, often reproduced from other references. It is not always clear whether the opinion being expressed is that of the referenced author, or of Mr. Rase himself. In the case of ethylene oxide, the mechanism presented has long gone out of favor, including the erroneous conclusion of a cap on maximum selectivity.

The sections on catalyst types, suppliers and licensors are sometimes unclear as to whether a licensor is also a supplier of catalyst or not, and vice versa. Incidentally, some names of catalyst producers and licensors are misspelled.

The section on catalyst deactivation for ethylene oxide describes many poisoning mechanisms but makes no mention of the most important cause of catalyst aging — sintering during normal operation. Another unfortunate typo is the mention of Ce (rather than Cs), as an “alkali salt” used in regeneration.

The process units section might not have been expected in this book, but having it should be useful. It would be preferable to furnish a simple process flow diagram to go along with the text. The process kinetics section usually ends each catalyst subject, and this section comes from one or more references.

The appendix contains an index of products and another of reactants. Upon looking up methanol as a product, the text referred to the MTBE reaction, one product of which is methanol.

Nonetheless, this is an extremely useful book if one wants to know which company might be the source of a catalyst or process license for a particular technology or product. With the expansion of material presented for each product or class of reaction, it is an endless job to keep all material current, and thus inclusion of some inaccuracies and less timely information are understandable. However, there is cause for concern when some material is well out of date. For the next edition, Mr. Rase might consider reducing some of the text and details while supplying up-to-date bibliographies in each section.

Joseph V. Porcelli, PhD

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Shape and Structure, from Engineering to Nature

Adrian Bejan

Cambridge University Press, Cambridge, U.K., 324 pp., \$39.95, 2000

This book provides some intriguing insights into the workings of both the natural world and that of engineering design. Bejan demonstrates that the structures we see around us — from river drainage basins to trees, from lungs to patterns in boiling spaghetti — can be deduced from the principles of constrained optimization. Engineering concepts predict nature, reversing the way we have been taught to think.

At the core of the book is the concept of constructal theory: “For a finite-size open system to persist in time it must evolve in such a way that it provides easier and easier access to the imposed currents that flow through it.” Bejan uses this principle to explain phenomena as diverse as laminar to turbulent flow transitions, the geometry of snowflakes and structures in society. The result is fascinating, but not for the faint-hearted. The author assumes prior knowledge in many different fields on the part of the reader, and in places, the mathematical analysis is a bit arduous. However, the book is extremely well written, and the discussion is supported by clear graphical illustrations and some delightful photographs.

Due to the diversity of the topics addressed, the book could be used as a text or supplement for advanced courses in many disciplines, including engineering design, physics and even economics. Problems are included to reinforce the concepts presented. Practicing engineers may or may not find direct applications for lessons learned from the book. However, we can gain a new understanding of many things we had previously taken for granted, and the added perspective should result in better thinking and, consequently, better solutions in our professional work. Even if it doesn't, a better understanding of the world in which we live is of great intrinsic value, and more than enough reason to invest in this excellent book.

Alan Rossiter

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