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REVIEWS

Fundamentals of Momentum, Heat and Mass Transfer. By J. R. WELTY, C. E. WICKS and R. E. WILSON. Wiley, 1976. 789 pp. $27.55.

Fundamental Principles of Heat Transfer. By S. WHITAKER. Pergamon, 1977. 556 pp. $50.00.

Each of the books reviewed here is directed primarily at undergraduate students and each covers a field which is already well served by existing texts. Pedagogical value is, therefore, the issue at hand; and the opinions expressed by this reviewer are accordingly highly arguable.

The book by Welty, Wicks & Wilson (WWW) is readily compared with the now classic *Transport Phenomena* of Bird, Stewart & Lightfoot (BSL). In each case, the intent is an integrated treatment of fluid mechanics, heat transfer and mass transfer; and the WWW book follows the BSL model very closely. The authors even suggest that it may be taught by either a 'vertical' or a 'horizontal' approach whereas BSL was designed to be taught by either 'columns' or 'rows'. Nonetheless, the differences are significant and would be welcomed by many, particularly for use as an introductory text. For instance, the 'shell balances' of BSL are largely absent and an integral control volume approach is used in their stead. In addition, much of the more advanced material of BSL is simply not present. The authors are therefore able to devote relatively more explanatory discussion to the simpler aspects of the subject and also to include much more material directed at applications such as the design of heat and mass exchangers. In many cases, the educational design is quite attractive. For example, the use of the Kármán integral method for boundary-layer analysis is presaged by a similar application in the context of transient heat transfer. The text includes a large number of worked problems and each chapter is followed by a substantial number of problems which are left as exercises for the student.

Unfortunately, the consummate care which was so obviously devoted to the preparation of BSL was not likewise lavished upon WWW. A few examples may serve to make this point: the derivation on pages 316 and 317 is awkward and would be confusing even if a factor of two were not first lost and then recovered; the sketches accompanying figures 22.9*b* and 22.9*c* are not appropriate to the associated graphs; the charts of appendix F are referred to in chapter 18 as 'Heissler (*sic*) Charts', but in chapter 27 they are 'Gurney–Lurie' charts; and SI units appear to be a problem for the authors since the values of $g\beta\rho^2/\mu^2$, as stated in the SI portion of table I, are erroneous, and the Stefan–Boltzmann constant is twice assigned incorrect values. Other sins are to be found and the effect on the beginning student is likely to be a loss of confidence in the reliability of the text. This is unfortunate because, as stated above, the design of the text is excellent for many purposes. One might hope that it will soon be reprinted with corrections and minor changes.

The Whitaker book is also not free from typographical errors, and has an abundance of unattached participles and split infinitives. It is written in a familiar first person plural ('We can define...', '...our film temperature...', etc.), which is not to

everyone's taste. Nonetheless, and more to the point, the meaning is always clear and the facts are never in doubt.

The sequence is conventional: conduction, convection, radiation, and a final chapter on heat exchangers. Despite the inevitability of this ubiquitous format, a number of appealing and distinguishing features manage to emerge. The readership of this journal in particular will be appreciative of an introductory heat-transfer text which reflects an acute appreciation of the underlying continuum and fluid mechanics. In addition, the treatment of radiative transfer is comparatively extensive, relatively novel, and very welcome. Order-of-magnitude analysis, much used but seldom discussed, is happily included as a separate topic. In all cases, the arguments proceed with care and with the inclusion of considerable detail.

The use of a 'design problem' to preface each chapter should also prove to be an excellent motivational device. Many of these 'design problems' and many of the other worked problems in the text are quite unconventional. Topic areas range from the design of a pre-heater for the feed stream to a distillation column, to a consideration of the thermal outfall of a nuclear power plant, to a consideration of the annual temperature variation in Lake Tahoe. The problems offered at the end of the chapters tend to be more conventional, and one might have wished for the inclusion of more problem-solving aids within the text itself. For instance, the only transient response curves included are those for the centre-line temperature of a slab and for the centre-line temperature of a cylinder. One suspects, however, that Whitaker's intention was to provide a sound introduction to the discipline and to promote a style of thought which would enhance the ability of a student to attack novel problems. It would appear that he has succeeded in precisely these objectives. K. A. SMITH

Computational Methods in Engineering and Science. By S. NAKAMURA. Wiley-Interscience, 1977. 457 pp. $25.00.

On a quick inspection the book looks well presented and the contents judged from the chapter and section headings would appear to be well chosen for the audience of graduate engineers and scientists to whom it is directed. However on reading the book in depth, I found the phrasing of many of the sentences awkward and cumbersome, and there are an enormous number of grammatical errors. Most of these would not seriously prejudice the understanding of the reader who is already familiar with most of the subject material, but it would undoubtedly reduce the reading speed. However, for those 'graduate' students who are *new* to the subject, I believe that such errors would divert the reader's attention from the methods and techniques being described, and in addition would impede comprehension.

Perhaps adding substance to my belief that the book has lacked serious proof-reading, there are also a number of technical and mathematical errors. Some are trivial, others are potentially less 'transparent' and might go unnoticed unless they were brought to the notice of the student. To add to the potential confusion, there are also some inconsistencies in notation at various places throughout the book.

So much for the presentation. What about the content? The book can be divided into two broad parts, each containing five chapters, the first four of which cover various aspects of computational numerical analysis, and the fifth of which concludes with examples taken from fluid dynamics.

The first chapter reviews the fundamental numerical analysis which is required in

the succeeding material. There follow three chapters on the numerical solution of eigenvalue problems, of elliptic and of parabolic partial differential equations. The fifth chapter introduces fluid dynamics. First the characteristic equation is derived for one-dimensional flow and its solution by the method of characteristics is described. A section on the control-volume method which is often used for transient analysis of coolant flow in nuclear power plants is followed by two brief sections outlining the vorticity/stream-function method for two-dimensional incompressible flow (including a rather scant treatment of boundary conditions) and the marker-and-cell method using the primitive variables of velocity and pressure.

The second group of five chapters covers more advanced computational numerical methods. The first two chapters describe the weighted residual method and variational principles, followed by an outline of finite-element methods with examples in stress analysis and incompressible viscous fluid flow. The coarse mesh rebalancing scheme, for which the author indicates considerable favour, forms the substance of chapter 8. The ninth chapter describes the interesting use of Monte-Carlo methods for solving particle-transport and heat-transport equations, including the use of variable step length methods. Finally chapter 10 describes some computational methods for aerodynamics including subsonic and transonic flows. The chapter concludes with descriptions of fast direct methods (such as those employing fast Fourier transforms or cyclic reduction) for solving the Poisson-type equations, and how they can be applied to the Cauchy–Riemann equations.

Although in a number of places the ordering of the sections could be improved, overall the material content of the book is good. Undoubtedly, were it not for the points already mentioned in the first part of this review, I could recommend the book for its survey of computational numerical analysis for engineers and scientists. However, regrettably, the poor grammar and style together with a significant number of actual errors mean that I believe it would be a poor choice as a recommended text – a suitably revised and 'corrected' second edition would be infinitely more acceptable.

D. A. H. JACOBS

SHORTER NOTICES

Boundary Layers in Homogeneous and Stratified–Rotating Fluids. By J. S. FEIN. University Microfilms International, 1978. 128 pp. $15.25.

This book is a careful amalgamation by J. S. Fein of lectures on rotating and stratified fluids given by A. R. Robinson and V. Barcilon at Florida State in 1967. The two subjects, which closely overlap, are treated in more detail than is customary in the literature. Explicit formulae are given at all stages, so that a worker in the area may use the book as a tool in the solution of any problem of interest. Notation has been standardized between the two lecturers. The only apparent flaw is the inversion of eight pages of text.

Stochastic Processes in Chemical Physics: The Master Equation. Edited by I. OPPENHEIM, K. E. SHULER and G. H. WEISS. MIT Press, 1977. 561 pp. $19.95.

The first quarter of this book consists of an introduction to stochastic processes and the master equation, presented in a style suitable for students and research workers

in chemical physics. The remainder of the book consists of reprints of 27 research papers in this field dated between 1957 and 1972, photographically reproduced. These are divided into eight sections, each of which is preceded by a brief commentary. The sections are entitled: derivation of the master equation; some general properties of the master equation; the relation between the Fokker–Planck and master equation; first passage time problems; gas phase relaxation processes; chemical kinetics; spin relaxation processes; dynamics of chain molecules.

Generalized Thermodynamics. By L. TISZA. MIT Press, 1977. 384 pp. $6.95.

This first appeared in 1966. It consists of 12 papers, of which four were newly written for the occasion, and eight were reprints of research papers previously published. The first six papers form an account of the author's development of macroscopic thermodynamics, with some applications in the field of phase transitions. There are four papers concerned with statistical thermodynamics, and two of a philosophical nature. A principal aim of the author was to strengthen the unity of the theories of physics. The present paperback reprint makes no changes other than the insertion of a loose page commenting on the relation of the work to the more recent developments on critical exponents, and promising to tell us more about this shortly. It also lists some errata.

Proceedings of the 1978 Heat Transfer and Fluid Mechanics Institute. Edited by C. T. CROWE and W. L. GROSSHANDLER. Stanford University Press, 1978. 329 pp.

The 21 papers in this volume were presented at a conference held at Washington State University in June 1978, which had energy conservation as its theme. This theme does not single out just one branch of fluid mechanics, but rather incorporates many. Consequently the fluid-mechanical topics covered by the papers range through hypersonic-boundary-layer stability, convection in a complex geometry, pressure drop in a two-phase stratified flow and the spectra of Reynolds stresses in pipe flow. The editors have grouped the papers into six sections, of which five start with abstracts of invited general lecturers. The book has been printed by direct reproduction of typescript.