examples will have to suffice. Mundane topics like material and energy balancing are treated in an easily comprehensible manner and include a nitric acid flowsheet as an extended example. The chapter on piping, instrumentation and control is refreshingly devoid of Laplace transforms and matrices, yet gives practical recipes for common equipment control problems. Similarly, costing and materials selection is given a practical gloss. Special mention must go to the chapter on design information and data: it is educationally important that students encounter unusual materials and this chapter provides a useful starting point for estimating the unknown physical properties.

It is easy to understand the popularity of this book amongst generations of students, for it provides under one cover everything they appear to need to know for their final projects. The tutor's task is to show that, while it is indeed incredibly useful, it is only the beginning and far from the end of the story.

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Thermodynamic optimization of finite time processes
R.S. Berry, V.A. Kazakov, S. Sieniutycz, Z. Szwast and A.M. Tsirlin, John Wiley and Sons Ltd., 1999, 471 pp., £ 120.00 (hardback), ISBN: 0-471-967521

The book is an impressive monograph treating many of the results in finite-time thermodynamics for the last 25 years. Although the emphasis is perhaps a little heavy on the results of the Russian school, the number of examples treated and the unity achieved is certainly a welcome addition to the literature in the field. The authors begin the book with their stated goal: "to show how the methods of optimal control theory can be used to estimate the limiting possibilities of thermodynamic systems." They carry out this goal to a remarkable extent.

The book begins with a brief review of the basic thermodynamics of closed and open systems. The closing section of Chapter 2 does a particularly elegant job of laying out a framework for the formulation and solution of finite-time thermodynamics problems including the much-needed disclaimers of exactly what the subject can and cannot do.

The book continues in Chapter 3 with a well written treatment of optimisation theory which starts where a normal calculus sequence leaves off, and takes the reader through a thorough treatment of finite-dimensional non-linear programming. Chapter 4 continues their exposition of optimisation theory with a good introduction to optimal control. In this chapter, the style changes somewhat interspersing the exposition with numerous examples of finite-time thermodynamics problems that illustrate the theory as it is developed. Their treatment of optimal control theory is novel, in that it includes an excellent development of the so-called 'average theorems' due to Rozonoer and Tsirlin. These theorems are of vital importance to many results in finite-time thermodynamics but are not part of the normal treatment in any other optimal control theory book. These theorems, along with the assumption of endoreversibility, reduce many finite-time thermodynamics problems to non-linear programming problems in finite dimensions. One important achievement of the book is to make these results accessible to a wide audience without requiring excessive prior knowledge of optimisation theory.

The remaining chapters present a systematic review of the problems in finite-time thermodynamics. The organisation proceeds from simpler systems, in which there are a limited number of heat exchangers and reservoirs, to more complex systems that interact with a number of reservoirs and incorporate mass transfer and chemical reactions. The number of problems presented is impressive and certainly represents a significant synthesis well beyond the reviews of the subject that were available before this monograph.

The book is not without some minor flaws, however. One weakness concerns the authors' use of the English language. English is not the mother tongue of four of the five authors and the book would have benefited from more corrections of an editorial nature. The abuse of the definite and indefinite articles in many of the sections makes for some difficult reading. There are also some unfortunate choices of nomenclature. For example, the use of NP for the non-linear programming problem clashes with the usage in combinatorial optimisation for NP hard problems. Phrases, such as 'poweral efficiency' for an efficiency based on power, are less than judicious.

A second flaw is the limitation in scope resulting from the complete omission of certain topics. Notable among these are (1) results dealing with the geometry of thermodynamic length and the associated bounds they give on the dissipation in finite-time processes, (2) results dealing with the thermodynamics of quantum systems, and (3) results relating to the processes driven by solar energy. These areas have all been significantly impacted by the ideas and methods of the finite-time thermodynamics and some mention of them in the book would have been desirable. It is true, however, that inclusion of these topics would have forced the already 500 page book to be significantly longer, and this fact probably played a significant role in the authors' decision to omit these topics.

Finite-time thermodynamics is not a mature field. The present text represents a real step forward in collecting so many results and putting them into a cohesive framework presented at the level of detail that a student willing to put in some effort could follow. The field holds great promise not only for industrial systems, which the authors' analysis treats well, but also for biological systems, quantum systems and for the general understanding of our universe. In summary, the book represents a major contribution to the literature in this area and deserves space on the bookshelf of any worker in this and related fields.

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Fundamentals of equilibrium and steady-state thermodynamics

Nicholas W. Tschoegl, Elsevier Science BV, 2000, 266 pp, US$ 183.50 (hardback), ISBN 0 444 50426 5

Teaching thermodynamics is a challenge. Normally a lecture is based on the students' experience and knowledge of elementary mechanics and physics. On this basis, the concepts of thermodynamics are introduced and the laws of thermodynamics and its consequences seem to follow naturally. Therefore, the logical structure of thermodynamics is often hidden behind the empirical knowledge. To clarify the theoretical concepts, it is useful to review such elementary courses in the light of clear postulates. Tschoegl did this in an advanced course at the California Institute of Technology. The material presented there has now been worked over, resulting in this book.

In this respect, thermodynamics can be compared to geometry. Almost everybody knows the elementary operations in geometry, but it has been a long and tedious process to put all the properties of the Euclidian geometry on an axiomatic basis. The main difficulty is to distinguish between what we know from experience and what we know proven from the postulates.

Nicholas Tschoegl has tried the same for steady-state and equilibrium thermodynamics: to put the logical structure (axiomatic or postulatory basis) in the centre of the presentation. Therefore, the book is structured into paragraphs comparable to theorems, lemmas or statements in a mathematical textbook. These paragraphs contain either a thermodynamic statement, its derivation from the postulates, or comments and applications. These paragraphs were grouped into chapters and the chapters were grouped into three parts (Equilibrium Thermodynamics, Steady-State Thermodynamics and Appendices).

The basis of the book are the definitions and the postulates as described above. Every statement is proven or at least explained in terms of these definitions and postulates. Of course it is not done so strictly and rigorously as in a textbook about axiomatic geometry, but the logical structure comes out clearly. However, more care should have been taken with the proper formulation of the definitions (for example, on page 7, 1.13 reversible process: "A reversible process is conducted ... in such a manner that the system and its surroundings are restored to their initial state". Obviously the word 'are' should be replaced by 'can be', and on page 4, 1.4: "Work is the transfer energy to the microscopically observable co-ordinates of motion". Energy is not transferred to co-ordinates; it is transferred to the system, resulting in a change of co-ordinates). Moreover, the term 'observable' is not defined. Therefore, in this 'postulatory' approach, former experience and the logical structure have again been mixed and not clearly separated. Consequently the goal of the book is only partially met.

Nevertheless, the other parts of the book, where the author follows more or less the usual arguments of thermodynamics, are very appealing and clearly written. It can be used very easily as the basis of an advanced course about the principles.

The book is attractive to everybody who is interested in the theoretical foundations of thermodynamics and especially to lecturers of elementary and advanced courses.

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