plicability to the rational design of polymer processing units.

The second part of the book (and portions of the first part) rapidly catalyzes the classical dichotomy concerning curricula in universities, say, training versus education, or perhaps better knowledge versus culture. Whatever the specific field of science, two philosophies conflict: on the one side, one may wish to train the graduate with a specific, well-organized body of technical knowledge which enables him to be directly useful in some segment of the productive world, but at the risk of becoming obsolete in a rapidly changing technology; on the other side, one may wish to educate the graduate by teaching him the fundamentals of scientific thought, leaving the acquisition of specific knowledge to his own ability on the job. Polymer science, being a field with a particularly high rate of evolution, is perhaps one of the best suited to the second approach. But even without stating so explicitly, it is the aspiration to realize freedom of thought, rather than any technical reason, that often makes the second approach the preferred one.

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Introduction to Thermodynamics: Classical and Statistical, R. E. Sonntag and G. J. Van Wylen, John Wiley & Sons, Inc., New York (1971). 813 pages. $13.95.

This introductory thermodynamics text is based largely on two earlier books by the same authors, *Fundamentals of Classical Thermodynamics*, and *Fundamentals of Statistical Thermodynamics*. According to the authors, this new edition has been written primarily to satisfy the need for a flexible teaching arrangement of the subject from both the classical and statistical points of view. The authors describe the organization of the book very well and recommend several possibilities for a two-semester course or a series of courses. They also supply many excellent examples and homework problems with answers which illustrate the practical applications of thermodynamic principles.

The first four chapters contain comprehensive discussions of large-scale equipment, units, concepts, definitions, and the properties of pure substances. Chapters 5 through 9 consider the basic first- and second-law principles for situations of both fixed and flowing mass. Chapter 10 discusses power plant and refrigeration cycles in considerable depth. Chapters 11 through 14 present a broad treatment of the application of thermodynamics to mixtures of ideal gases, chemical reactions, equations of state, phase equilibrium, and chemical equilibrium. The remaining five chapters concisely introduce statistical thermodynamics, including fundamental probability and statistics and quantum mechanics. Most of this material is usually included in conventional elementary statistical mechanics-thermodynamics courses; Bose-Einstein and Fermi-Dirac statistics, the Maxwell-Boltzmann velocity distribution, the properties of gases (not considering potential energy between molecules), and the properties of solids (the Einstein and Debye solids, and the electron gas in a metal). While some difficulties may be encountered with the abstract concepts, a study of the many problems should provide students with a workable knowledge of statistical concepts in thermodynamics.

Several shortcomings in the book come to mind for the teaching of potential chemical engineers. First, the book fails to adequately treat the thermodynamics of solutions. The authors' treatment is focused on mixtures of perfect gases, and the lack of a general definition of an ideal mixture may leave the student with the mistaken impression that such mixtures are in some way confined to mixtures of perfect gases. Nothing is mentioned of excess properties, activity coefficients, etc., which are important to the chemical engineer and which, should probably be introduced to him in his beginning thermodynamics course.

Another insufficiency is the meager treatment of intermolecular forces. Nowhere in the text could this reviewer find even a sketch of the intermolecular potential function or how it could be used to explain deviations from the ideal gas law, condensation, or many other fundamental concepts of interest to chemical engineers. Finally, the placement of references at the end of the book makes it difficult, particularly for the self-study student, to examine specific subject matter from other points of view.

Apart from these deficiencies, it can be said that the overall quality of the book is good as it is well organized, easily read and has considerable breadth and flexibility.

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Chemical Reactor Theory: An Introduction, Second edition, K. G. Denbigh and J. C. R. Turner, Cambridge University Press, England (1971). 224 pages. $10.00.

The second edition incorporates changes that will appeal to those who would use it as a textbook, although it is basically still a short, concise review of basic chemical reactor theory. This edition features problems within the text, better grouping of material, and a new chapter on mass transfer effects. The book is a very readable summary of chemical kinetics and reactor design and is recommended as an up-to-date review on the subject.

The first two chapters briefly but adequately introduce reactor types and chemical rate expressions. A chapter on tubular reactors and one on continuous stirred tank reactors follows. A discussion of nonideal behavior includes good examples.

Chapter five considers the use of residence-time distributions in estimating reactor performance. This area has perhaps been overemphasized in recent years, but the authors give a practical review on the subject. Placement of this material in a separate chapter makes it easier to assimilate.

The next chapter treats the effect of chemical factors on reactor type. This excellent chapter discusses yield and selectivity and focuses on the practical aspects of reactor choice.

Chapter seven is new and covers mass transfer effects. It adds to the book but is a very brief outline of the subject.

Chapter eight discusses the thermal characteristics of reactors, and Chapter nine considers reactor stability and optimization. New problems have been added, but there is still a lack of comprehensive problems to illustrate these important aspects of chemical behavior.

In summary, the text highlights the important features of reactor design and is recommended as a current review on the subject. The new edition can be used as a text, but additional material should be provided to supplement it.

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Transport Phenomena for Engineers, Louis Theodore, International Textbook Co., Scranton, Pennsylvania (1971). 338 pages. $12.00.

The title of this undergraduate text is misleading, as the book is inadequate as the sole exposure of engineering students to transport phenomena. There is no treatment of radiation, boiling, natural convection, compressible flow, nonequimolar counterdiffusion, and not much connection between the equations of change and the actual computation of transport rates. Such topics are left to unit operations courses. Rather, the book is intended to be more introductory and fundamental, although a purported senior level course is somewhat late for this. Dr. Theodore reveals a great deal of patience in presenting derivations and numerous examples in much detail; these are very repetitious, however, and the book could be shortened considerably with no loss of content.

After a brief introduction and a chapter on vector analysis, one chapter each is devoted to momentum, energy, and mass transfer. The equations of change are derived with a control volume approach using Gauss' divergence theorem and constitutive relations for constant density fluids, but without reference to kinematics, thermodynamics, or molecular considerations. The derivations are followed by example problems involving the calculation of velocity, temperature, and concentration profiles in slab, cylindrical, and spherical geometries. The next chapter presents similar problems on simultaneous transport and reproduces some poorly identified computer listings. The last chapter, an introduction to turbulence, ends with definitions of friction factor and heat and mass transfer coefficients.

Many deficiencies prevent recommendation of the book, even for its intended purpose and scope. First, a number of concepts are presented incorrectly or inadequately, in this reviewer's opinion, including Newton's second law of motion ("derived" by dimensional analysis in the FMLT system), pressure, internal energy, reference frames for mass and molar diffusion fluxes, and the boundary layer equations.

Second, there are quite a few careless statements and strangely fabricated phrases. For example, throughout the book the expression "rate of momentum" denotes rate of change of momentum (similarly for energy and mass); "shear stress tensor" denotes the negative of the viscous stress (or extra stress) tensor, which includes normal stresses as well; "force gradients," instead of force fields or potential gradients; "average density," when total or global density is meant; "dimensionless analysis," instead of dimensional analysis; "Newtons' second law," meaning Newton's law of viscosity; and so on.

Finally, there are some noticeable omissions. For example, the book contains no reference citations or bibliography, yet such mathematical tools as Bessel functions, Fourier series, Gauss-Jordan elimination, and Gamma functions are used without explanation. There is insufficient emphasis on the constant-density limitations throughout the text, there are no warnings of numerical instabilities or divergences, the definition of dot product involving tensors or dyads is missing, and Stokes' integral theorem is stated but never used.

Unfortunately, these shortcomings obscure the book's merits. An extensively revised and abridged version could be useful in continuing education or refresher courses for those with no previous exposure to vector analysis or the equations of change.

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Theory of Viscoelasticity: An Introduction, R. M. Christensen, Academic Press. New York (1971). 245 pages. $13.50.

The dominant theme in this book is the development of several aspects of the continuum mechanics theory of linear viscoelasticity. Since four of the seven chapters are devoted entirely to the linear theory and the others briefly describe three other areas of viscoelasticity, the word *linear* in the title would have been helpful for guiding the proper readers to this book.

The first four chapters consider the linear theory of viscoelasticity. In chapter one the constitutive equation for the isothermal infinitesimal theory is derived from the fading memory hypothesis, and the behavior of the relaxation function and the creep function are presented. Chapter two consists of a series of solutions to a variety of isothermal viscoelastic boundary value problems. A list of the problems solved is useful for determining the audience to which the author is writing; the examples include: torsional oscillation of a right circular cylinder, pressurization of a spherical cavity, and indentor on a beam. A linear theory of thermoviscoelasticity is developed in Chapter three. Chapter four consists of solutions to several wave propagation problems using both the isothermal and nonisothermal viscoelasticity theories.

Chapter five is a collection of general theorems which the author states "are extensions to viscoelasticity of some of the well-known theorems of elasticity." Included are uniqueness of solution, reciprocal, variational, and minimum theorems. Chapter six presents the development of the nonlinear theory of viscoelasticity in which the stress-strain relationship is derived as an expansion of linear functionals. Finally, Chapter seven describes methods of determining mechanical properties with the major emphasis on those methods used to obtain the linear viscoelasticity functions.

Although this book is subtitled as an introduction, the reader must have sufficient background to understand a rather high level of mathematics and some previous knowledge of the subject of mechanics. To understand the theoretical development presented in this book the reader will need some understanding of the following mathematical terms: Stieltjes convolution notation, Riesz representation theorem, and Fréchet differentials. The reader should also have some introductory work in the area of mechanics since the author defines the concepts of stress and strain only briefly.

Throughout the book the author prefers to keep the theoretical development as general as possible. In the chapters in which problems are solved few comparisons with experimental data are made, and with regard to numerical solutions for the problems, although a few are given, the author's philosophy is that "it is not possible to give detailed numerical solutions and expect the results to have any degree of generality."

With the emphasis on the linear theory and the knowledge that most viscoelastic-fluid processing problems require at a minimum a nonlinear representation of the viscosity function, the reader should place his interest in this book either on solidifying his understanding of the theoretical development of constitutive equations or on understanding the solutions to certain problems arising with viscoelastic solids where the linear theory is applicable.

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