Transport Modeling for Environmental Engineers and Scientists

By Mark M. Clark, Wiley, New York, 1996, 559 pp., $69.95.

Much of environmental engineering involves transport processes. Environmental engineering undergraduates are exposed to a course in fluid mechanics, but curricula usually stop short of mass transfer and almost never include chemical reaction engineering unless the student takes the basic chemical engineering courses. The undergraduate education in environmental engineering really would benefit from the full-year transport phenomena sequence that is the bread-and-butter of undergraduate chemical engineering curricula. One drawback of simply sending all environmental engineering undergraduates over to a local chemical engineering department to take the transport phenomena sequence is that applications that have historically been focused upon in the ChE course are not those of most interest in environmental engineering. Mark Clark of the University of Illinois Civil Engineering Department has written this text that can serve as the basis of a year-long course in transport processes at the junior/senior level in civil and environmental engineering. The basic fundamental development of the subject will be familiar to ChE students; what distinguishes the book is the selection of applications. After an introductory chapter on conservation relations, chapters on particle suspensions, interaction of charged particles, and adsorption and phase partitioning are presented. The next three chapters treat basic fluid mechanics, mass transfer, and convective diffusion. Then follows a chapter on filtration and flow in porous media. Recognizing that civil/environmental engineering students rarely are exposed to concepts of chemical reaction engineering, the author devotes the final two chapters to kinetics and mixing and reactor modeling. The book is clearly written and nicely illustrated; it should be an effective classroom text and deserves consideration for adoption by civil engineering departments.

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Thermodynamics, Second Edition

N. A. Gokcen and R. G. Reddy, Plenum Press, New York, 1996, 400 pp. $59.50.

This second edition, like its predecessor (Gokcen, 1975), is a concise textbook emphasizing aspects of classical thermodynamics of importance to students and professionals in materials science. Distinguishing features of the book are the authors' succinct writing style and axiomatic approach to the fundamental laws, affording a very compact, readable text. Throughout the book, the empirical basis of thermodynamics is reinforced with discussions of experimental measurement of important thermodynamic quantities. The book is comparable in content to Gaskell's *Introduction to the Thermodynamics of Materials*, though it is considerably shorter (400 vs. ~550 pages). Since it does not cover thermodynamics of flow processes or refrigeration/power cycles, it is probably not appropriate as an undergraduate text for chemical engineers. However, the book has been used in materials science undergraduate programs at several universities. Students and professional engineers working on materials related problems will find that it is a useful reference.

The book begins by introducing the concept of state functions, defining terms such as work, heat, and thermal equilibrium (Chapter 1), and reviewing basic mathematical methods important to thermodynamics (Chapter 2). The mathematical review includes (but is not limited to) discussion of differentiation, integration, maxima, minima, and inflection points, Lagrange's method of undetermined multipliers, Legendre transformations, determinants, and series expansions. Concentration of these mathematical methods in a single chapter early in the text frees the authors to employ these methods later without having to explain them, and provides the reader with a convenient reference. The next four chapters introduce the First and Second Laws, volumetric and thermodynamic equations of state, the Fundamental Equation, heat capacities, the absolute temperature scale, the Gibbs and Helmholtz functions, and the concepts of reversibility and irreversibility. As is common in thermodynamics texts which emphasize materials problems, the heat capacities of both gases and solids are introduced in the same chapter along with the atomistic models (such as the kinetic theory of gases and the Debye-Einstein model, respectively) which account for their functional form. The seventh chapter provides a detailed discussion of the Third Law, experimental determinations of entropy changes, and statistical interpretations of entropy. Chapters 8 to 11 develop the usual machinery needed to describe phase equilibrium, that is, partial molar properties, the concept of the ideal mixture, excess Gibbs energy, fugacity, and activity in real mixtures. Chapter 12 discusses reaction equilibria with particular emphasis on experimental methods for determining standard Gibbs energy changes. The last four chapters focus on thermodynamics of electrolyte solutions, electrochemical cells, phase diagrams, and special topics including surface tension, order-disorder phase transitions, and incorporation of gravitational, electric, and magnetic fields into the fundamental equations.

The book has six appendices which include a list of general references, thermodynamic data tables for a number of compounds and elements, estimates of ion activities in electrolyte solutions, and a discussion of stability diagrams (such as Pourbaix diagrams). A floppy disk with "Thermodynamics Simulation" software is also supplied with the book. The program allows calculation of enthalpy and Gibbs energy changes as a function of temperature for solid-state reactions (predominantly). However, the program is obviously in early stages of development and needs to be improved before it becomes truly useful.

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