BOOKS

Advanced Process Control by W. H. Ray McGraw-Hill Book Co., 376 pages, $33.50 (1980).

This book is intended as a text for a second-level course in process control for advanced undergraduate or graduate students. It is also suitable for self-study by engineers in industry. In view of the author's well-deserved reputation as a leading researcher in advanced control and estimation techniques, it is not surprising that the book emphasizes modern control theory. The mathematical prerequisites for the book are quite modest: elementary matrix analysis and an introduction to ordinary differential equations.

The contents of the book are as follows. The short introductory chapter discusses the incentives for using advanced control concepts and introduces the dynamic models that are considered in the book. Chapter 2 describes the hardware associated with a typical computer control scheme. This chapter is intended to provide the reader with an appreciation for the effort and equipment required to implement computer control schemes.

The third chapter, "Control of lumped Parameter Systems," is chiefly concerned with the design of optimal feedback control systems for linear and nonlinear state-space models. Noninteracting control schemes and the Relative Gain Array are also considered. Multivariable frequency domain techniques such as the Inverse Nyquist Array Method are only mentioned in passing.

Control strategies for distributed parameter systems are considered in Chapter 4. Several lumping techniques for converting first- and second-order partial differential equations (PDE) into ordinary differential equations (ODE) are described including the method of characteristics, modal analysis, and the method of weighted residuals. The thorough treatment of optimal control policies for PDE models in this chapter is a distinctive feature of this book. Chapter 4 concludes with a discussion of time delay compensation techniques and optimal control policies for time-delay systems.

State estimation techniques for both lumped parameter and distributed parameter systems is the subject of Chapter 5. Emphasis is placed on optimal state estimation techniques such as the Kalman filter. An introduction to stochastic control theory is also included. The author has wisely decided to present the basic features of state estimation rather than rigorous derivations involving advanced statistics. Consequently, only a rudimentary knowledge of statistics is required.

The final chapter consists of four detailed case studies which illustrate the application of the advanced control and estimation techniques described in the preceding chapters. The case studies include two pilot-scale experimental units, a double effect evaporator and a heated ingot, and two simulation studies, a sidestream distillation and a continuous steel casting operation.

The book is concise and well written and has a surprisingly small number of typographical errors. The large number of physical examples and the Case Studies in Chapter 6 are effectively used to demonstrate key features in designing advanced control systems. The chief shortcoming of this book is the omission of material on sampled-data control systems and digital control algorithms. In view of the widespread interest and application of digital control, it would seem appropriate to devote a signifiant portion of a second-level course to the design and analysis of digital control systems. The book does not include material on two other topics which are currently receiving widespread attention: adaptive control and predictive control techniques.

Despite these omissions, this book is easily the best available text on advanced process control.

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Gas Tables: International Version Second Edition (SI Units) Joseph H. Keenan, Jing Chao, and Joseph Kaye, John Wiley and Sons, New York, New York, 1983, 211 pp., $37.95.

The book represents a companion volume of the second edition of *Gas Tables* in English units published by the same authors in 1980. The coverage of both books is the same and indeed Tables 24 through 59 are identical. These tables present the polytropic functions and compressible flow functions for gases. The main independent variables in these tables are the Mach number, the exponent for a polytropic process and the pressure ratio and these variables are independent of the choice of units. The book contains a detailed description of the sources of data. A rather extensive description of the methods used to calculate the values presented in the various tables is given. The ideal gas thermodynamic properties are calculated by employing the methods of statistical mechanics. For diatomic molecules this includes translational, rotational, vibrational, electronic and anharmonicity terms. The explicit equations for the partition function are given. The book includes 21 examples which serve to illustrate the use of many of the tables. These examples are presented in detail and should provide enough information to allow a novice to use the Tables in a very short time. Tables 30 to 53 cover the one-dimensional compressible flow functions. These tables contain the functions useful in many engineering problems in the one-dimensional flow of a perfect gas with constant specific heat and molecular weight. In particular, the book introduces the Fanno line and the Raleigh line and treats their use.

While the book has been prepared primarily for mechanical engineers, it is of value to any engineer needing properties of gases under static or flowing conditions. The book also contains some physical constants and conversion factors. As the trend of the future is towards international conformity in the use of SI units, perhaps this version is the more appropriate one for inclusion in a university or company library.

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Flow Phenomena in Porous Media, by Robert A. Greenkorn, published by Marcell Dekker (1983), 560 pages, $75.00.

If you are serious about this area, this is a book that you must buy. I had already purchased my copy, and my students were using it before I was asked to write this review.

This is a field of broad appeal extending considerably beyond chemical engineering. Yet relatively few books have been written attempting to summarize work in the area. I was delighted to see Professor Greenkorn take the time from his busy schedule as vice president and associate provost of Purdue University to share with us his point of view.