in order to increase effectiveness in illustrating a concept, use of open-ended problems is suggested. In research, the requirement of original research proposals as part of the degree requirements and faculty-student interaction in proposal writing are additional suggestions for consideration. Efforts should be made to improve student communication and motivational skills since they play a vital role in later careers, whether in teaching or in industry.

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ChE ***book review***

MODELING WITH DIFFERENTIAL EQUATIONS IN CHEMICAL ENGINEERING
by Stanley M. Walas

Butterworth-Heinemann, Stoneham, MA; $145, (1991)

Reviewed by
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Today there is a recognized need for teaching a course in mathematical methods to undergraduate chemical engineers, and several schools have begun offering such courses. But there are only a few textbooks available that are primarily addressed to chemical engineering students. This book by Walas is therefore a very timely addition to the literature. It is an excellent book.

The book consists of fifteen chapters and an appendix. Chapters 1 to 7 focus on mathematical methods of solutions of ordinary and partial differential equations. Integral equations are briefly treated in Chapter 6. Theoretical discussions, such as existence and uniqueness of solutions, have been skipped and instead, emphasis has been placed on solution techniques and detailed applications. All classical methods of solution are covered in detail. Numerical and approximate methods are emphasized early on throughout the presentation. The material is well presented, and a wealth of references for further reading are provided. These chapters give the student a good background in the different methods (analytical, numerical, and approximate) for solving ODEs and PDEs. Limitations of the techniques are clearly explained, and methods for overcoming the difficulties are presented.

After the mathematics of differential equations has been presented, there is a chapter devoted to the principles of the mathematical formulation of engineering processes. What follows next is the distinctive part of this book—the derivations and solutions of differential equations of some of the major disciplines of chemical engineering. The topics covered include thermodynamics, mass transfer, fluid flow, heat transfer, chemical reactions and reactor design, and process control. Attention is restricted primarily to the differential equations that occur in these processes. Many of the topics are reinforced by mathematical or numerical examples as well as problems for the reader, most of them with answers provided.

Throughout the book the author guides the reader toward more comprehensive sources of information, and the reference list is excellent and up to date. Little mathematics beyond calculus is expected of the reader. Computer usage by the examples and problems is restricted to readily available user-friendly PC diskettes. The treatment of most topics is fairly complete, and beginning students will not need to relearn the material as their sophistication advances.

Overall, this book will satisfy the demands of undergraduate and first-year graduate chemical engineering students who usually have difficulty in understanding the presentations in more general mathematics texts. The book may also be of value to those who have already mastered the typical chemical engineering curriculum, *e.g.*, the chemical engineering practitioner, and who are now involved in some aspect of computational or mathematical modeling of chemical engineering processes.

In summary, this is a highly recommendable textbook for senior and beginning graduate students, set apart by an easy style, a healthy amount of exercises, lots of references, and a wide coverage of topics. The author is to be commended for his excellent effort and contribution to the chemical engineering literature. ❐