BOOK REVIEWS

Linear Operator Methods in Chemical Engineering

By D. Ramkrishna and N. Amundson, Prentice-Hall, Englewood Cliffs, NJ, 471 pp., 1985, $51.95

When one considers the relevance of functional analysis in chemical engineering curriculum for graduate students, three particular reasons stand out: modern development in numerical analysis, parameter estimation and sensitivity analysis, and unification of seemingly diverse fragments in the theory of linear differential operators. This new text provides an introduction to functional analysis with applications in the theory of linear differential operators at a level suitable for students who have mastered an introductory course in engineering mathematics. Students familiar with the first half of this book will also have an easier time with entry level texts on modern numerical methods.

This book was used as a required text in a one-semester course at the University of Wisconsin and this review includes remarks that are drawn from that experience.

The first two chapters (0, 1) of LOMChE condense the elements of real analysis into 23 pages. In the undergraduate mathematics curriculum, a course in real analysis is a prerequisite for functional analysis. Engineering students are not familiar with this material and this portion of the course required careful discussion, e.g., the motivation for various definitions.

Linear algebra as described in Chapter 2 is likely to be more abstract than material encountered in previous courses on matrix manipulations, but the approach sets the tone for later materials.

In Chapter 3, "Metric Spaces," concepts such as the metric, convergence of sequences, Cauchy sequences, continuity of functions, interior points, open and closed sets, limit points, closure of a set, compact sets, complete metric spaces, dense sets, etc., and associated theorems are introduced and derived. Many new concepts are introduced here so this portion of the course presents the greatest challenge to both instructor and student.

Chapter 4 introduces Lebesque integration and measure theory which achieves two results: it introduces an important example of completion of a metric space (space of Lebesque integrable frunctions vs. Riemann integrable functions); it also prepares important examples of Banach and Hilbert spaces that appear in later chapters.

Chapters 5 and 6 cover normed linear spaces and inner product spaces. Chapter 5 highlights concepts and theorems that require only the existence of a norm (instead of the full machinery of the inner product). The topology induced by the norm, the natural norm induced by the inner product, norm of an operator, compact operators, Banach spaces, Hilbert spaces, the Riesz Representation Theorem and adjoint of an operator are presented in these two chapters.

Chapters 0 through 6 may be viewed as preparation for applications found in later chapters. As mentioned earlier, the ideas presented in these chapters have other applications. Chapter 7 features a rigorous derivation of the spectral theorem for both finite- and infinite-dimensional Hilbert spaces. The derivation is essentially complete. Chapter 8 presents applications in finite-dimensional spaces such as multicomponent distillation problems.

In Chapters 9 and 10 (ODEs and PDEs respectively), the conversion of self-adjoint differential operators into integral equations via Green's functions is discussed in the context of the construction of compact inverses. Here we see the fruits of a course based on LOMChE. Instead of the usual arguments on the advantage of integral equations over differential equations, here, the advantage is evident.

The book ends with an introduction to nonself-adjoint operators and biorthogonal expansions (Chapter 11). It is interesting to note that during the same semester, the biorthogonal expansion was applied successfully by one of the students to resolve a research problem.

The authors have included enough material for a two-semester course including many thought-provoking exercises. Our one-semester course covered all of Chapters 1, 2, 3, 5, 6, 7 with appropriate references to material in Chapters 0 and 4 and one topic from Chapters 9, 10 and 11 each. The syllabus was intentionally in favor of foundation material over applications. A slower pace can be set by reducing the emphasis on Chapters 1, 2 and 3. Other combinations are mentioned in the preface.

In summary, this book is an excellent introduction to functional analysis for applications in linear operator theory. The aims as embodied in the title have been achieved without major omissions. Some of the typographical errors may hamper students who are reading this book on their own, but these minor flaws most likely will be corrected before the next printing. Numerous transport and reaction engineering applications make this book especially suitable for self-study by graduate students.

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Process Analyzer Technology

By K. J. Clevett, John Wiley and Sons, Inc., 1986, 952 pp., $105.00

This book addresses a wide range of process analyzers, including chromatog-

raphy, viscosity, boiling point, flash point, pour point, cloud point, vapor pressure, oxygen, density, hydrogen sulfide, total sulfur, spectrometric, moisture, air quality, water quality (including plt), heating value, octane number, thermal conductivity, and refractive index. The related subjects of sample systems, calibration, maintenance, and control are also covered. Although the book focuses primarily on process applications of analyzers, laboratory methods are also included. Its main strength is its comprehensive coverage of the various measurement technologies.

The chapter of each type of measurement includes a description of the products available commercially to perform the measurement. This coverage is very well-done, but unfortunately will become dated as the manufacturers continue with their product development.

The book clearly does not assume that the reader is a chemical engineer. Although review of topics such as the Nernst equation is appropriate, chemical engineers need not be reminded that the forward/reverse arrows signify a reversible reaction. Thus, the orientation is more to insturment specialists than to process engineers.

Those hardware-oriented subjects, such as how the various analyzers are constructed (electrically, mechanically, and otherwise), are covered well. Some attention is directed to the process considerations, such as what type of analyzer is best suited for a particular application and what process conditions could lead to unsatisfacotry results. But by not assuming a chemical engineering background on the part of the reader, the book will disappoint those desiring an in-depth coverage of such topics.

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Pressure Gauge Handbook

By P. W. Harland, Editor, Marcel Dekker, Inc., 1985, 292 pp.

This book focuses on bourdon-type pressure gauges, rather than the strain gauge, capacitance or piezoresistive types that require external energy sources such as electricity to make them function. In essence, the book is concerned with pressure gauges in which some form of elastic member is deflected by pressure and this motion is translated through suitable links and levers, and gears to the pointer on an indicator scale.

The book starts with an introductory chapter in which the basic ideas of pressure are defined including pressure units and the kinds of pressure. This is followed by chapters 2–4 which present common variations in construction of pressure gauges as well as define the nomenclature associated with these particular types of gauges.

In chapter 5, the accessories available for use with pressure gauges are discussed that improve performance and expand the range of usefulness. For example, for cases where the pressure is pulsating rapidly, the gauge will be rapidly destroyed. By the addition of pulsation dampers that restrict the flow of fluid into the gauge, this destructive effect can be mitigated. Chapters 6 and 7 deal with the selection, installation and recalibration of a gauge to restore its accuracy.

In chapter 8 ways in which pressure gauges can be used to measure temperature are discussed. Although the primary concern of the book is with pressure-driven gauges, chapter 9 is concerned with the general ideas behind externally-powered pressure transducers. This material is included in case the pressure-driven-type gauges are inadequate for a particular application. This chapter, however, is quite limited and does not get into the types of pressure gauges available for applications such as in the plastics industry. Chapter 10 discusses the safety considerations that must be made by users, suppliers, and manufacturers of pressure gauges. In light of a tendency to use different pressure units, chapter 11 shows the relation among various pressure units. Finally, in Chapter 12 is given an outline for ordering and giving specifications to the manufacturer.

As stated in the preface of the book, it is intended for use by practicing engineers who must select pressure-driven-type gauges for various applications. Although the book is limited to just this class of pressure-driven-type gauge, it is quite thorough and detailed. It is a worthwhile reference book for those industries concerned with the processing of low-viscosity fluids and gasses. It is of very limited use for those engineers involved in the processing of polymer melts.

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Handbook of Separation Process Technology

By Ronald W. Rousseau, Ed., John Wiley and Sons, Inc., XIX, 1010+ pp., 1987, $69.95

This handbook is a new and welcome addition to the separations literature and represents the first effort of its type in many years. The book features an interesting arrangement, beginning with a good dose of appropriate theory in Part I, General Principles, followed by detailed descriptions of specific separation processes in Part II, Individual Separation Processes.

The chapters have been written by internationally recognized experts and about one half of the authors are from industry or have extensive industrial backgrounds. This provides a good balance of both the practical and the theoretical aspects of the subject. Each chapter in Part II has a good mix of fundamental principles, design procedures, examples of commercial equipment, and discussions of the application of the particular technique. The chapters are concluded with sections on the notation used. This is extensive and well done and is followed by a detailed bibliography.

The chapter titles are: Chapter 1. Phase Equilibria, Chapter 2. Mass Transfer Principles, Chapter 3. Phase Segregation, Chapter 4. General Processing Considerations, Chapter 5. Distillation, Chapter 6. Absorption and Stripping, Chapter 7. Extraction-Organic Chemicals Processing, Chapter 8. Extraction-Metals Processing, Chapter 9. Leaching-Metals Applications, Chapter 10. Leaching-Organic Materials, Chapter 11. Crystallization Operations, Chapter 12. Adsorption, Chapter 13. Ion Exchange, Chapter 14. Large-Scale Chromatography, Chapter 15. Separation Processes Based on Reversible Chemical Complexation, Chapter 16. Bubble and Foam Separations-Ore Flotation, Chapter 17. Bubble and Foamation Separations-Waste Treatment, Chapter 18. Ultrafiltration and Reverse Osmosis, Chapter 19. Recent Advances in Liquid Membrane Technology, Chapter 20. Separation of Gaseous Mixtures Using Polymer Membranes, Chapter 21. Membrane Processes-Dialysis and Electrodialysis, and, Chapter 22. Selection of a Separation Process.

The first chapters in Part I cover the fundamental aspects of separations tech-