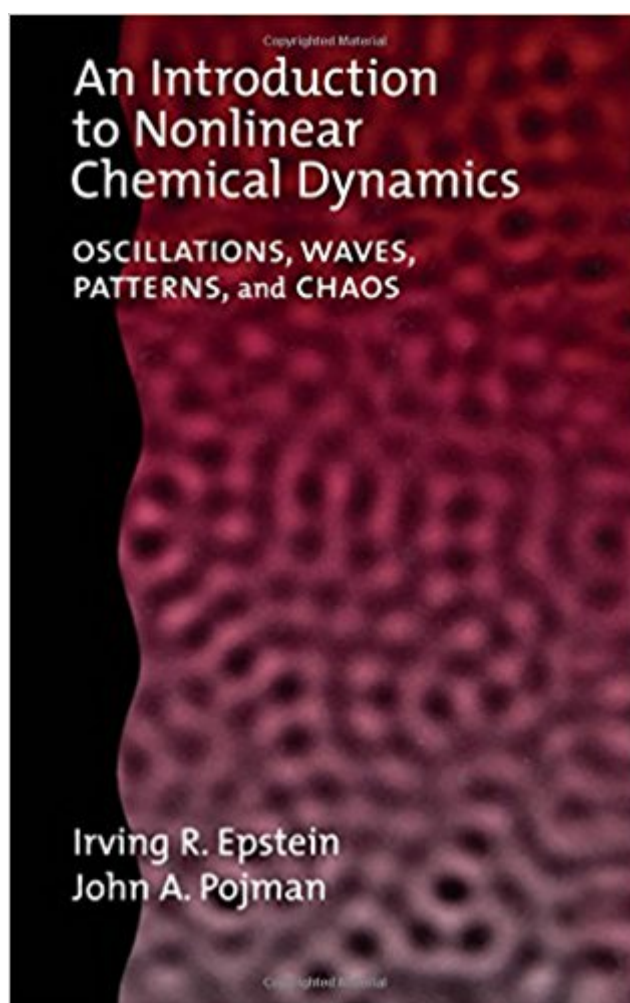


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An Introduction To Nonlinear Chemical Dynamics: Oscillations, Waves, Patterns, And Chaos (Topics In Physical Chemistry)



Synopsis

Just a few decades ago, chemical oscillations were thought to be exotic reactions of only theoretical interest. Now known to govern an array of physical and biological processes, including the regulation of the heart, these oscillations are being studied by a diverse group across the sciences. This book is the first introduction to nonlinear chemical dynamics written specifically for chemists. It covers oscillating reactions, chaos, and chemical pattern formation, and includes numerous practical suggestions on reactor design, data analysis, and computer simulations. Assuming only an undergraduate knowledge of chemistry, the book is an ideal starting point for research in the field. The book begins with a brief history of nonlinear chemical dynamics and a review of the basic mathematics and chemistry. The authors then provide an extensive overview of nonlinear dynamics, starting with the flow reactor and moving on to a detailed discussion of chemical oscillators. Throughout the authors emphasize the chemical mechanistic basis for self-organization. The overview is followed by a series of chapters on more advanced topics, including complex oscillations, biological systems, polymers, interactions between fields and waves, and Turing patterns. Underscoring the hands-on nature of the material, the book concludes with a series of classroom-tested demonstrations and experiments appropriate for an undergraduate laboratory.

Book Information

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"Offers an introduction to nonlinear chemical dynamics written especially for chemists, covering oscillating reactions, chaos, and chemical pattern formation. Begins with a brief history of nonlinear

chemical dynamics and a review of necessary mathematics and chemistry, then provides an overview of nonlinear dynamics, starting with the flow reactor and moving on to a detailed discussion of chemical oscillators. Later chapters cover advanced topics such as biological systems, polymers, and interactions between fields and waves. Includes a series of classroom-tested demonstrations and experiments appropriate for an undergraduate laboratory. Assumes an undergraduate knowledge of chemistry. Epstein is a professor of chemistry at Brandeis University. Pojman is a professor of chemistry and biochemistry at the University of Southern Mississippi."--SciTech Book News"Nonlinear chemical dynamics is a young, rapidly developing field . . . Irving Epstein and John Pojman's [book] is intended to provide an introduction to the field at the advanced undergraduate or introductory graduate level . . . The book, written in a pleasant, informal style, covers a wide range of topics, for which it provides both representative and illustrative examples and a good coverage of the literature. . . . [T]he book covers, for the first time, certain important topics that had been missing in the literature at this level, such as external fields, delays, polymer systems, and stirring effects. It also provides useful information on the operational aspects of chemical reactors. All in all, the book constitutes a source of information to which both students and teachers interested in nonlinear science in general and in nonlinear chemical dynamics in particular may advantageously turn to complete a more technically oriented training."--Physics Today"Intense study of oscillating chemical reactions and nonlinear dynamics in chemistry is only about 30 years old, but there has been enormous progress in understanding this fascinating and important area of chemistry. This advance was triggered in the 1960s by two nearly simultaneous developments. The first was Ilya Prigogine's theory of dissipative structures (an early form of complexity theory). The second was the discovery . . . of an unequivocal chemical example, . . . (the Belousov-Zhabotinsky reaction), in which oscillations in $[\text{Br}^-]$ and in $[\text{Ce}(\text{IV})]/[\text{Ce}(\text{III})]$ are easily observed. This book is a comprehensive overview of the area and covers basic chemistry, underlying theory, experimental methods, and applications. . . . This book belongs within easy reach of any person either working in the area or in daily contact with people, especially students, who nowadays hear of these topics from many sources and who wish to learn more about them."--Journal of Chemical Education"On the back cover of the book, it is stated that the book is written for chemists with an undergraduate education. That is far too modest. The book appears to me more like an encyclopedia or a handbook, and not only for undergraduates. In fact, it does touch on a bit of everything in the field....A beginner in any discipline could use it for research inspiration and as a starting point....Detailed and instructive accounts are given of the classification of models and mechanisms..., cross-shaped diagrams for the design of oscillators, the slow-manifold picture of

mixed-mode oscillations, the handling of delay equations, chemical coupling, neural oscillators, and double-diffusive convection....Chemical recipes are given in the appendixes. Summing up: the book is not for experts, nor is it popular science. It is for any chemist, physicist, biologist, or mathematician, from the undergraduate to the professor, who wishes to be introduced to this beautiful area."--The Chemical Intelligencer"This book is not the first book written on this subject, but it may be the most readable. The authors are both chemists with impressive research credentials in the field of nonlinear chemistry. Throughout the book, the authors give useful tips and warnings about the pitfalls that one might encounter. As a bonus for the reader, the authors have included recipes for preparing the Belousov-Zhabotinsky reaction, the Briggs-Rauscher reaction, and the polymer reactions that exhibit chemical waves. These recipes can be used for demonstrations and undergraduate laboratory work. For students who wish to learn about the field, this book is an excellent starting place." -- Linda E. Reichl, Journal of the American Chemical Society, Vol 122, No 16"This book tells the fascinating story of chemical and biological oscillations and chaos, waves, and patterns. The authors are established researchers in their own right. The introduction gives a lively and authentic account of the early history of this emergent discipline, which makes for entertaining anecdotal reading. The emergent discipline of nonlinear chemical dynamics has become richer with this very good textbook, which is particularly strong in the authors' own research field and somewhat heterogeneous in the special topics. It is a valuable guide to the nonspecialist and it is most suitable for undergraduate and graduate courses with its well-selected demonstrations and its many references...highly recommendable text both stimulating and rewarding." -- F.W. Schneider, SIAM Review, Vol 42, No 2, 2000

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