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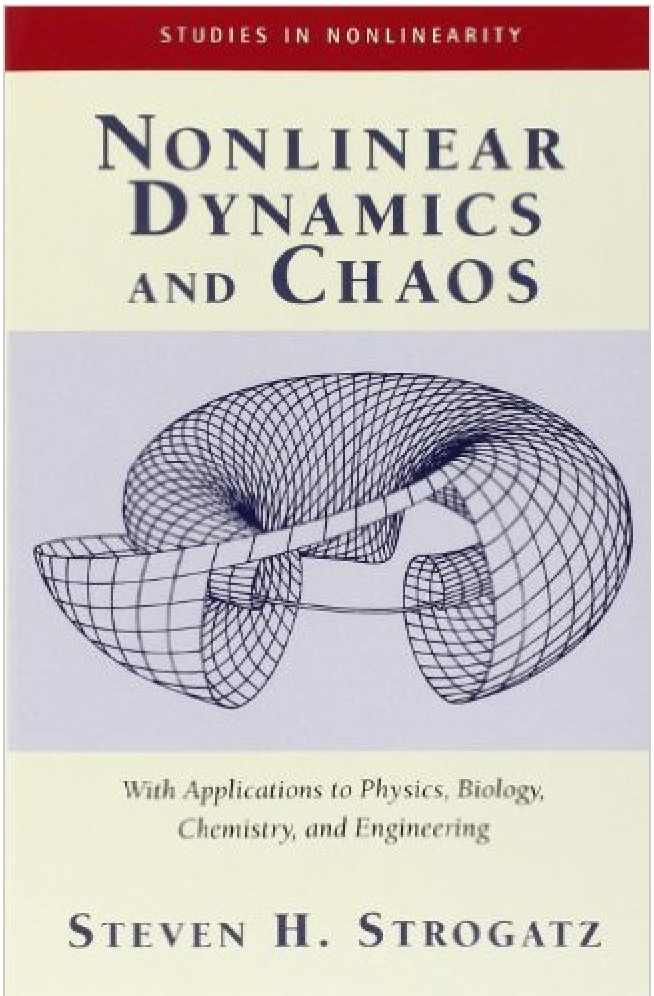
Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering (Studies In Nonlinearity)



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Synopsis

This textbook is aimed at newcomers to nonlinear dynamics and chaos, especially students taking a first course in the subject. The presentation stresses analytical methods, concrete examples and geometric intuition. The theory is developed systematically, starting with first-order differential equations and their bifurcations, followed by phase plane analysis, limit cycles and their bifurcations, and culminating with the Lorenz equations, chaos, iterated maps, period doubling, renormalization, fractals, and strange attractors.A unique feature of the book is its emphasis on applications. These include mechanical vibrations, lasers, biological rhythms, superconducting circuits, insect outbreaks, chemical oscillators, genetic control systems, chaotic waterwheels, and even a technique for using chaos to send secret messages. In each case, the scientific background is explained at an elementary level and closely integrated with the mathematical theory.Richly illustrated, and with many exercises and worked examples, this book is ideal for an introductory course at the junior/senior or first-year graduate level. It is also ideal for the scientist who has not had formal instruction in nonlinear dynamics, but who now desires to begin informal study. The prerequisites are multivariable calculus and introductory physics.

Book Information

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Customer Reviews

It is rare that books of this type are both comprehensive and readable. Strogatz has managed to cover a wide range of concepts in significant detail while providing examples to illustrate his major points.The beginning of the text starts of with one dimensional nonlinear systems of first order (like the logistic equation), and Strogatz outlines the typical framework that one uses to analyze such systems. He defines fixed points, illustrates and defines bifurcations, and solidifies every claim with good examples.The text eventually moves to higher order systems with coupled or non-coupled sets of differential equations. For the most part, exercises for the student involve sets of two differential equations that can be linearized using Jacobian methods.Later, Strogatz provides a nicely executed description of fractals and fractal dimension, using examples from the Cantor set and the von Koch curve.The beauty of the book is that it is well written and complete. It even provides some limited solutions to selected exercises in the back. The examples in the book cover a wide range of areas. Mechanical oscillating systems like a mass on a spring, electrical circuits that follow the same equations, laser models that follow a modified logistic equation, and many variations of the Lotka-Volterra model are outlined through examples in the text.The book is a stand-alone text, equally useful as a textbook for an intorductory course or as a reference for someone merely surveying the subject. It deserves the highest rating possible.Edit: 2/28/07Now with a few years of hindsight, I would say this might have been the best stand alone textbook I had in grad school. This was one of the few books I had where I could teach myself the subject matter by just reading it. It is a great book that takes the mysticism out of a new and growing field.

Were all Math books written like this, the number of students majoring in Math, Physics, etc. would rise considerably. The presentation is clear, lucid and comprehensive. Each concept is introduced with its motivating phenomena and the mathematical treatment is logical and elegant with many worked examples. This is one of those rare Math books that "begin at the beginning", yet go on to develop the concepts to a point useful even to grad students who want a review of basics before plunging into more advanced material. (If you are looking for more detailed mathematical stuff, I’d suggest Kevorkian’s "Multiple Scale and Singular Perturbation Methods" or "Perturbation Methods" by Hinch.)For the benefit of those reviewers who have complained that the mathematics is not rigorous enough, may I point out that the author clearly states the book is an introduction to the topic. I have come across other introductory books using basic differential equations, on similar topics where the material is presented in a disjointed way. Strogatz, however, shows us the inter-relatedness of the broad range of concepts and applications that fall within the title. Therein lies a major strength of this book.Another big plus is that Strogatz presents those intermediate diagrams and results that take us to the final conclusion. Also he interprets the Math en route to the finale. He does not employ the usual "it is apparent that ..." strategy to pole-vault to miracle steps. This approach makes the book a breezy read; a remark not commonly made about advanced Math books!

Not sure if it’s a limitation of the kindle, but all equations with a dot (e.g. x derivative w.r.t. time or x dot, second x derivative w.r.t. t or x double dot) are rendered as images, even if they are in the middle of a sentence. This makes the kindle version of an otherwise great (5 star) book very painful to read. (I am attaching a screenshot from the kindle sample)

The second edition kept that exceptional quality of the first one, but added only a few new examples. If one already has the first edition, which is my case, the second one is totally dispensable.

I am using this book as a "practice-first" guide to mathematics for the guy in his thirties, who struggles to understand why his high education was not done right 15 years ago, and do it so by himself this time.Accompanied by the lectures on the subject (search the title on youtube), this is likely the best book on math out there for motivated unexperienced reader.It will throw you to many practical fields of mathematics, and, having enough time, one can continue wandering and hunting for different subjects while eating this dish chapter by chapter (or lecture by lecture). For me, who has the luxury of not following any education plan, this is a delicious experience.

This book is an excellent introductory graduate level text on nonlinear dynamics for those who wish to understand the basic concepts before seeing the mathematical rigor at the heart of the subject. Strogatz avoids getting caught up in mathematical nuances which often cloud the big picture for non-math students, and thereby clearly impresses upon the reader the essence of nonlinear dynamics, eventually building up to chaos. The examples and problems are truly unique and inspiring. This book is an excellent starting place for someone who knows little or nothing about nonlinear dynamics but has done some basic work with linear differential equations and linear algebra.

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