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**KEY=NONLINEAR - SHANIA TOWNSEND**

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**NONLINEAR DYNAMICS AND CHAOS**

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**WITH APPLICATIONS TO PHYSICS, BIOLOGY, CHEMISTRY, AND ENGINEERING**

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CRC Press **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.**

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**STUDENT SOLUTIONS MANUAL FOR NONLINEAR DYNAMICS AND CHAOS, 2ND EDITION**

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CRC Press **This official Student Solutions Manual includes solutions to the odd-numbered exercises featured in the second edition of Steven Strogatz's classic text Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering. The textbook and accompanying Student Solutions Manual are aimed at newcomers to nonlinear dynamics and chaos, especially students taking a first course in the subject. Complete with graphs and worked-out solutions, this manual demonstrates techniques for students to analyze differential equations, bifurcations, chaos, fractals, and other subjects Strogatz explores in his**

popular book.

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## **INTRODUCTION TO APPLIED NONLINEAR DYNAMICAL SYSTEMS AND CHAOS**

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Springer Science & Business Media **This introduction to applied nonlinear dynamics and chaos places emphasis on teaching the techniques and ideas that will enable students to take specific dynamical systems and obtain some quantitative information about their behavior. The new edition has been updated and extended throughout, and contains a detailed glossary of terms. From the reviews: "Will serve as one of the most eminent introductions to the geometric theory of dynamical systems." -- Monatshefte für Mathematik**

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## **NONLINEAR DYNAMICS AND CHAOS**

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### **WITH APPLICATIONS TO PHYSICS, BIOLOGY, CHEMISTRY, AND ENGINEERING**

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Westview Press **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 mathematical theory. In the twenty years since the first edition of this book appeared, the ideas and techniques of nonlinear dynamics and chaos have found application to such exciting new fields as systems biology, evolutionary game theory, and sociophysics. This second edition includes new exercises on these cutting-edge developments, on topics as varied as the curiosities of visual perception and the tumultuous love dynamics in *Gone With the Wind*.**

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## **NONLINEAR DYNAMICAL SYSTEMS AND CHAOS**

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Birkhäuser **Symmetries in dynamical systems, "KAM theory and other perturbation theories", "Infinite dimensional systems", "Time series analysis" and "Numerical continuation and bifurcation analysis" were the main topics of the December 1995 Dynamical Systems Conference held in Groningen in honour of Johann Bernoulli. They now form the core of this work which seeks to present the state of the art in various branches of the**

theory of dynamical systems. A number of articles have a survey character whereas others deal with recent results in current research. It contains interesting material for all members of the dynamical systems community, ranging from geometric and analytic aspects from a mathematical point of view to applications in various sciences.

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## **PROBLEMS AND SOLUTIONS**

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### **NONLINEAR DYNAMICS, CHAOS AND FRACTALS**

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World Scientific Publishing Company This book presents a collection of problems for nonlinear dynamics, chaos theory and fractals. Besides the solved problems, supplementary problems are also added. Each chapter contains an introduction with suitable definitions and explanations to tackle the problems. The material is self-contained, and the topics range in difficulty from elementary to advanced. While students can learn important principles and strategies required for problem solving, lecturers will also find this text useful, either as a supplement or text, since concepts and techniques are developed in the problems.

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### **NONLINEAR SYSTEMS**

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Cambridge University Press This book introduces the mathematical properties of nonlinear systems, mostly difference and differential equations, as an integrated theory, rather than presenting isolated fashionable topics.

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### **INSTABILITIES, CHAOS AND TURBULENCE**

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World Scientific This book (2nd edition) is a self-contained introduction to a wide body of knowledge on nonlinear dynamics and chaos. Manneville emphasises the understanding of basic concepts and the nontrivial character of nonlinear response, contrasting it with the intuitively simple linear response. He explains the theoretical framework using pedagogical examples from fluid dynamics, though prior knowledge of this field is not required. Heuristic arguments and worked examples replace most esoteric technicalities. Only basic understanding of mathematics and physics is required, at the level of what is currently known after one or two years of undergraduate training: elementary calculus, basic notions of linear algebra and ordinary differential calculus, and a few fundamental physical equations (specific complements are provided when necessary). Methods presented are of fully general use, which opens up ample windows on topics of contemporary interest. These include complex dynamical processes such as patterning, chaos control, mixing, and even the Earth's climate. Numerical simulations are proposed as a means to obtain deeper understanding of the intricacies induced by nonlinearities in our everyday environment, with hints on adapted modelling strategies and their implementation.

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## **DIFFERENTIAL DYNAMICAL SYSTEMS, REVISED EDITION**

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**SIAM** Differential equations are the basis for models of any physical systems that exhibit smooth change. This book combines much of the material found in a traditional course on ordinary differential equations with an introduction to the more modern theory of dynamical systems. Applications of this theory to physics, biology, chemistry, and engineering are shown through examples in such areas as population modeling, fluid dynamics, electronics, and mechanics. Differential Dynamical Systems begins with coverage of linear systems, including matrix algebra; the focus then shifts to foundational material on nonlinear differential equations, making heavy use of the contraction-mapping theorem. Subsequent chapters deal specifically with dynamical systems concepts—flow, stability, invariant manifolds, the phase plane, bifurcation, chaos, and Hamiltonian dynamics. This new edition contains several important updates and revisions throughout the book. Throughout the book, the author includes exercises to help students develop an analytical and geometrical understanding of dynamics. Many of the exercises and examples are based on applications and some involve computation; an appendix offers simple codes written in Maple, Mathematica, and MATLAB software to give students practice with computation applied to dynamical systems problems.

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## **CHAOS AND NONLINEAR DYNAMICS**

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### **AN INTRODUCTION FOR SCIENTISTS AND ENGINEERS**

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Oxford University Press, USA **Mathematics of Computing -- Miscellaneous.**

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## **DYNAMICS OF SMART SYSTEMS AND STRUCTURES**

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### **CONCEPTS AND APPLICATIONS**

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**Springer** Written by a team of experts that has been working together for several years in the context of a research network involving international institutions, this book brings several applications related to smart material systems such as vibration and noise control, structural health monitoring, energy harvesting and shape memory alloys. Furthermore, this book also provides basic knowledge on the fundamentals of smart material systems and structures. Consequently, the present title serves as an important resource for advanced undergraduate and graduate students. In addition, it serves as a guide for engineers and scientists working with smart structures and materials both with an application and basic research perspective. Smart material systems and structures represent a new paradigm which is increasing the capabilities of engineering systems. Adaptability and versatility are some important aspects related to such systems. In brief, research on smart materials is characterized by synergistically combining different physical features, such as mechanical,

electrical, chemical, and magnetic. As a result, smart material technologies have a huge potential to enhance the performance of engineering structures opening unlimited opportunities to innovation and economic benefits.

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## **AN INTRODUCTION TO COMPLEX SYSTEMS**

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### **SOCIETY, ECOLOGY, AND NONLINEAR DYNAMICS**

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**Springer** This undergraduate text explores a variety of large-scale phenomena - global warming, ice ages, water, poverty - and uses these case studies as a motivation to explore nonlinear dynamics, power-law statistics, and complex systems. Although the detailed mathematical descriptions of these topics can be challenging, the consequences of a system being nonlinear, power-law, or complex are in fact quite accessible. This book blends a tutorial approach to the mathematical aspects of complex systems together with a complementary narrative on the global/ecological/societal implications of such systems. Nearly all engineering undergraduate courses focus on mathematics and systems which are small scale, linear, and Gaussian. Unfortunately there is not a single large-scale ecological or social phenomenon that is scalar, linear, and Gaussian. This book offers students insights to better understand the large-scale problems facing the world and to realize that these cannot be solved by a single, narrow academic field or perspective. Instead, the book seeks to emphasize understanding, concepts, and ideas, in a way that is mathematically rigorous, so that the concepts do not feel vague, but not so technical that the mathematics get in the way. The book is intended for undergraduate students in a technical domain such as engineering, computer science, physics, mathematics, and environmental studies.

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## **CHAOS**

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### **AN INTRODUCTION TO DYNAMICAL SYSTEMS**

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**Springer** **BACKGROUND** Sir Isaac Newton brought to the world the idea of modeling the motion of physical systems with equations. It was necessary to invent calculus along the way, since fundamental equations of motion involve velocities and accelerations, of position. His greatest single success was his discovery that which are derivatives the motion of the planets and moons of the solar system resulted from a single fundamental source: the gravitational attraction of the bodies. He demonstrated that the observed motion of the planets could be explained by assuming that there is a gravitational attraction between any two objects, a force that is proportional to the product of masses and inversely proportional to the square of the distance between them. The circular, elliptical, and parabolic orbits of astronomy were no longer fundamental determinants of motion, but were approximations of laws specified with differential equations. His methods are now used in modeling motion and

change in all areas of science. Subsequent generations of scientists extended the method of using differential equations to describe how physical systems evolve. But the method had a limitation. While the differential equations were sufficient to determine the behavior-in the sense that solutions of the equations did exist-it was frequently difficult to figure out what that behavior would be. It was often impossible to write down solutions in relatively simple algebraic expressions using a finite number of terms. Series solutions involving infinite sums often would not converge beyond some finite time.

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### **NONLINEAR DYNAMICAL SYSTEMS WITH SELF-EXCITED AND HIDDEN ATTRACTORS**

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Springer This book highlights the latest findings on nonlinear dynamical systems including two types of attractors: self-excited and hidden attractors. Further, it presents both theoretical and practical approaches to investigating nonlinear dynamical systems with self-excited and hidden attractors. The book includes 20 chapters contributed by respected experts, which focus on various applications such as biological systems, memristor-based systems, fractional-order systems, finance systems, business cycles, oscillators, coupled systems, hyperchaotic systems, flexible robot manipulators, electronic circuits, and control models. Special attention is given to modeling, design, circuit realization, and practical applications to address recent research problems in nonlinear dynamical systems. The book provides a valuable reference guide to nonlinear dynamical systems for engineers, researchers, and graduate students, especially those whose work involves mechanics, electrical engineering, and control systems.

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### **SYNCHRONIZATION IN COMPLEX NETWORKS OF NONLINEAR DYNAMICAL SYSTEMS**

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World Scientific This book brings together two emerging research areas: synchronization in coupled nonlinear systems and complex networks, and study conditions under which a complex network of dynamical systems synchronizes. While there are many texts that study synchronization in chaotic systems or properties of complex networks, there are few texts that consider the intersection of these two very active and interdisciplinary research areas. The main theme of this book is that synchronization conditions can be related to graph theoretical properties of the underlying coupling topology. The book introduces ideas from systems theory, linear algebra and graph theory and the synergy between them that are necessary to derive synchronization conditions. Many of the results, which have been obtained fairly recently and have until now not appeared in textbook form, are presented with complete proofs. This text is suitable for graduate-level study or for researchers who would like to be better acquainted with the latest research in this area. Sample Chapter(s).

**Chapter 1: Introduction (76 KB). Contents: Graphs, Networks, Laplacian Matrices and Algebraic Connectivity; Graph Models; Synchronization in Networks of Nonlinear Continuous-Time Dynamical Systems; Synchronization in Networks of Coupled Discrete-Time Systems; Synchronization in Network of Systems with Linear Dynamics; Agreement and Consensus Problems in Groups of Interacting Agents. Readership: Graduate students and researchers in physics, applied mathematics and engineering.**

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## **AN INTRODUCTION TO DYNAMICAL SYSTEMS AND CHAOS**

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[Springer](#) **The book discusses continuous and discrete systems in systematic and sequential approaches for all aspects of nonlinear dynamics. The unique feature of the book is its mathematical theories on flow bifurcations, oscillatory solutions, symmetry analysis of nonlinear systems and chaos theory. The logically structured content and sequential orientation provide readers with a global overview of the topic. A systematic mathematical approach has been adopted, and a number of examples worked out in detail and exercises have been included. Chapters 1-8 are devoted to continuous systems, beginning with one-dimensional flows. Symmetry is an inherent character of nonlinear systems, and the Lie invariance principle and its algorithm for finding symmetries of a system are discussed in Chap. 8. Chapters 9-13 focus on discrete systems, chaos and fractals. Conjugacy relationship among maps and its properties are described with proofs. Chaos theory and its connection with fractals, Hamiltonian flows and symmetries of nonlinear systems are among the main focuses of this book. Over the past few decades, there has been an unprecedented interest and advances in nonlinear systems, chaos theory and fractals, which is reflected in undergraduate and postgraduate curricula around the world. The book is useful for courses in dynamical systems and chaos, nonlinear dynamics, etc., for advanced undergraduate and postgraduate students in mathematics, physics and engineering.**

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## **COMPLEX SYSTEMS SCIENCE IN BIOMEDICINE**

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[Springer Science & Business Media](#) **Complex Systems Science in Biomedicine** **Thomas S. Deisboeck and J. Yasha Kresh** **Complex Systems Science in Biomedicine** covers the emerging field of systems science involving the application of physics, mathematics, engineering and computational methods and techniques to the study of biomedicine including nonlinear dynamics at the molecular, cellular, multi-cellular tissue, and organismic level. With all chapters helmed by leading scientists in the field, **Complex Systems Science in Biomedicine's** goal is to offer its audience a timely compendium of the ongoing research directed to the understanding of biological processes as whole systems instead of as isolated component parts. In Parts I & II, **Complex Systems Science in Biomedicine** provides a general systems thinking perspective and presents some of the

fundamental theoretical underpinnings of this rapidly emerging field. Part III then follows with a multi-scaled approach, spanning from the molecular to macroscopic level, exemplified by studying such diverse areas as molecular networks and developmental processes, the immune and nervous systems, the heart, cancer and multi-organ failure. The volume concludes with Part IV that addresses methods and techniques driven in design and development by this new understanding of biomedical science. **Key Topics Include:** • Historic Perspectives of General Systems Thinking • Fundamental Methods and Techniques for Studying Complex Dynamical Systems • Applications from Molecular Networks to Disease Processes • Enabling Technologies for Exploration of Systems in the Life Sciences

**Complex Systems Science in Biomedicine** is essential reading for experimental, theoretical, and interdisciplinary scientists working in the biomedical research field interested in a comprehensive overview of this rapidly emerging field. **About the Editors:** Thomas S. Deisboeck is currently Assistant Professor of Radiology at Massachusetts General Hospital and Harvard Medical School in Boston. An expert in interdisciplinary cancer modeling, Dr. Deisboeck is Director of the Complex Biosystems Modeling Laboratory which is part of the Harvard-MIT Martinos Center for Biomedical Imaging. J. Yasha Kresh is currently Professor of Cardiothoracic Surgery and Research Director, Professor of Medicine and Director of Cardiovascular Biophysics at the Drexel University College of Medicine. An expert in dynamical systems, he holds appointments in the School of Biomedical Engineering and Health Systems, Dept. of Mechanical Engineering and Molecular Pathobiology Program. Prof. Kresh is Fellow of the American College of Cardiology, American Heart Association, Biomedical Engineering Society, American Institute for Medical and Biological Engineering.

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## **THE NONLINEAR WORKBOOK**

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**CHAOS, FRACTALS, CELLULAR AUTOMATA, NEURAL NETWORKS, GENETIC ALGORITHMS, GENE EXPRESSION PROGRAMMING, SUPPORT VECTOR MACHINE, WAVELETS, HIDDEN MARKOV MODELS, FUZZY LOGIC WITH C++, JAVA AND SYMBOLIC++ PROGRAMS**

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World Scientific "The study of nonlinear dynamical systems has advanced tremendously in the last 20 years, making a big impact on science and technology. This book provides all the techniques and methods used in nonlinear dynamics. The concepts and underlying mathematics are discussed in detail." "The text has been designed for a one-year course at both the junior and senior levels in nonlinear dynamics. The topics discussed in the book are part of e-learning and distance learning courses conducted by the International School for Scientific Computing, University of Johannesburg."--BOOK JACKET.

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## **STUDENT SOLUTIONS MANUAL FOR NONLINEAR DYNAMICS AND CHAOS, 2ND EDITION**

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Westview Press This Student Solutions Manual contains solutions to the odd-numbered exercises in *Nonlinear Dynamics and Chaos*, second edition.

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### **NONLINEAR DYNAMICS OF NANOSYSTEMS**

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John Wiley & Sons A discussion of the fundamental changes that occur when dynamical systems from the fields of nonlinear optics, solids, hydrodynamics and biophysics are scaled down to nanosize. The authors are leading scientists in the field and each of their contributions provides a broader introduction to the specific area of research. In so doing, they include both the experimental and theoretical point of view, focusing especially on the effects on the nonlinear dynamical behavior of scaling, stochasticity and quantum mechanics. For everybody working on the synthesis and integration of nanoscopic devices who sooner or later will have to learn how to deal with nonlinear effects.

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### **NONLINEAR OSCILLATIONS, DYNAMICAL SYSTEMS, AND BIFURCATIONS OF VECTOR FIELDS**

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Springer Science & Business Media An application of the techniques of dynamical systems and bifurcation theories to the study of nonlinear oscillations. Taking their cue from Poincare, the authors stress the geometrical and topological properties of solutions of differential equations and iterated maps. Numerous exercises, some of which require nontrivial algebraic manipulations and computer work, convey the important analytical underpinnings of problems in dynamical systems and help readers develop an intuitive feel for the properties involved.

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### **CHAOTIC DYNAMICS**

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#### **AN INTRODUCTION**

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Cambridge University Press The previous edition of this text was the first to provide a quantitative introduction to chaos and nonlinear dynamics at the undergraduate level. It was widely praised for the clarity of writing and for the unique and effective way in which the authors presented the basic ideas. These same qualities characterize this revised and expanded second edition. Interest in chaotic dynamics has grown explosively in recent years. Applications to practically every scientific field have had a far-reaching impact. As in the first edition, the authors present all the main features of chaotic dynamics using the damped, driven pendulum as the primary model. This second edition includes additional material on the analysis and characterization of chaotic data, and applications of chaos. This new edition of *Chaotic Dynamics* can be used as a text for courses on chaos for physics and engineering students at the second- and third-year level.

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## MODELING LOVE DYNAMICS

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World Scientific

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## STUDENT SOLUTIONS MANUAL FOR STEWART/REDLIN/WATSON'S COLLEGE ALGEBRA, 6TH

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## DYNAMICAL SYSTEMS ON NETWORKS

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### A TUTORIAL

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Springer **This volume is a tutorial for the study of dynamical systems on networks. It discusses both methodology and models, including spreading models for social and biological contagions. The authors focus especially on “simple” situations that are analytically tractable, because they are insightful and provide useful springboards for the study of more complicated scenarios. This tutorial, which also includes key pointers to the literature, should be helpful for junior and senior undergraduate students, graduate students, and researchers from mathematics, physics, and engineering who seek to study dynamical systems on networks but who may not have prior experience with graph theory or networks. Mason A. Porter is Professor of Nonlinear and Complex Systems at the Oxford Centre for Industrial and Applied Mathematics, Mathematical Institute, University of Oxford, UK. He is also a member of the CABDyN Complexity Centre and a Tutorial Fellow of Somerville College. James P. Gleeson is Professor of Industrial and Applied Mathematics, and co-Director of MACSI, at the University of Limerick, Ireland.**

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## NONLINEAR DYNAMICS, MATHEMATICAL BIOLOGY, AND SOCIAL SCIENCE

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### WISE USE OF ALTERNATIVE THERAPIES

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CRC Press **These lectures develop simple models of complex social processes using nonlinear dynamics and mathematical biology. Dynamical analogies between seemingly disparate social and biological phenomena, revolutions and epidemics, arms races, and ecosystem dynamics, are revealed and exploited. Nonlinear Dynamics, Mathematical Biology, and Social Science invites social scientists to relax, in some cases abandon, the predominant assumption of perfectly informed utility maximization and explore social dynamics from such perspectives as epidemiology and predator-prey theory. The volume includes a concentrated course on nonlinear dynamical systems.**

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## AN INTRODUCTION TO DYNAMICAL SYSTEMS

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### CONTINUOUS AND DISCRETE

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American Mathematical Soc. This book gives a mathematical treatment of the introduction to qualitative differential equations and discrete dynamical systems. The treatment includes theoretical proofs, methods of calculation, and applications. The two parts of the book, continuous time of differential equations and discrete time of dynamical systems, can be covered independently in one semester each or combined together into a year long course. The material on differential equations introduces the qualitative or geometric approach through a treatment of linear systems in any dimension. There follows chapters where equilibria are the most important feature, where scalar (energy) functions is the principal tool, where periodic orbits appear, and finally, chaotic systems of differential equations. The many different approaches are systematically introduced through examples and theorems. The material on discrete dynamical systems starts with maps of one variable and proceeds to systems in higher dimensions. The treatment starts with examples where the periodic points can be found explicitly and then introduces symbolic dynamics to analyze where they can be shown to exist but not given in explicit form. Chaotic systems are presented both mathematically and more computationally using Lyapunov exponents. With the one-dimensional maps as models, the multidimensional maps cover the same material in higher dimensions. This higher dimensional material is less computational and more conceptual and theoretical. The final chapter on fractals introduces various dimensions which is another computational tool for measuring the complexity of a system. It also treats iterated function systems which give examples of complicated sets. In the second edition of the book, much of the material has been rewritten to clarify the presentation. Also, some new material has been included in both parts of the book. This book can be used as a textbook for an advanced undergraduate course on ordinary differential equations and/or dynamical systems. Prerequisites are standard courses in calculus (single variable and multivariable), linear algebra, and introductory differential equations.

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### CHAOS AND DYNAMICAL SYSTEMS

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Princeton University Press The author presents an accessible, clear introduction to dynamical systems and chaos theory, important and exciting areas that have shaped many scientific fields. While the rules governing dynamical systems are well-specified and simple, the behavior of many dynamical systems is remarkably complex.

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### EXPLORING ODES

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SIAM Exploring ODEs is a textbook of ordinary differential equations for advanced undergraduates, graduate students, scientists, and engineers. It

is unlike other books in this field in that each concept is illustrated numerically via a few lines of Chebfun code. There are about 400 computer-generated figures in all, and Appendix B presents 100 more examples as templates for further exploration.?

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## **INTRODUCTION TO MODERN DYNAMICS**

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### **CHAOS, NETWORKS, SPACE, AND TIME**

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Oxford University Press, USA **The best parts of physics are the last topics that our students ever see. These are the exciting new frontiers of nonlinear and complex systems that are at the forefront of university research and are the basis of many high-tech businesses. Topics such as traffic on the World Wide Web, the spread of epidemics through globally-mobile populations, or how the synchronization of global economies are governed by universal principles just as profound as Newton's laws. Nonetheless, the conventional university physics curriculum reserves most of these topics for graduate study because of the assumed need for advanced mathematics. However, by using only linear algebra and calculus, combined with exploratory computer simulations, all of these topics become accessible to advanced undergraduate students. The structure of this book combines the three main topics of modern dynamics - chaos theory, dynamics on complex networks, and general relativity - into a coherent framework. By taking a geometric view of physics, concentrating on the time evolution of physical systems as trajectories through abstract spaces, these topics share a common and simple mathematical language through which any student can gain a unified physical intuition. Given the growing importance of complex dynamical systems in many areas of science and technology, this text provides students with an up-to-date foundation for their future careers. This second edition has an updated introductory chapter and has added key topics to help students prepare for their GRE physics subject exam. It also has expanded chapters on Hamiltonian dynamics, Hamiltonian chaos, and Econophysics, while increasing the number of homework problems at the end of each chapter. The second edition is designed to fulfill the textbook needs of any advanced undergraduate course in mechanics.**

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### **NONLINEAR DYNAMICS IN COMPUTATIONAL NEUROSCIENCE**

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Springer **This book provides an essential overview of computational neuroscience. It addresses a broad range of aspects, from physiology to nonlinear dynamical approaches to understanding neural computation, and from the simulation of brain circuits to the development of engineering devices and platforms for neuromorphic computation. Written by leading experts in such diverse fields as neuroscience, physics, psychology, neural engineering, cognitive science and applied mathematics, the book reflects the remarkable advances that have been made in the field of**

computational neuroscience, an emerging discipline devoted to the study of brain functions in terms of the information-processing properties of the structures forming the nervous system. The contents build on the workshop “Nonlinear Dynamics in Computational Neuroscience: from Physics and Biology to ICT,” which was held in Torino, Italy in September 2015.

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### **CHAOTIC, FRACTIONAL, AND COMPLEX DYNAMICS: NEW INSIGHTS AND PERSPECTIVES**

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[Springer](#) The book presents nonlinear, chaotic and fractional dynamics, complex systems and networks, together with cutting-edge research on related topics. The fifteen chapters - written by leading scientists working in the areas of nonlinear, chaotic, and fractional dynamics, as well as complex systems and networks - offer an extensive overview of cutting-edge research on a range of topics, including fundamental and applied research. These include but are not limited to, aspects of synchronization in complex dynamical systems, universality features in systems with specific fractional dynamics, and chaotic scattering. As such, the book provides an excellent and timely snapshot of the current state of research, blending the insights and experiences of many prominent researchers.

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### **SYNC**

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### **HOW ORDER EMERGES FROM CHAOS IN THE UNIVERSE, NATURE, AND DAILY LIFE**

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[Hachette UK](#) At the heart of the universe is a steady, insistent beat, the sound of cycles in sync. Along the tidal rivers of Malaysia, thousands of fireflies congregate and flash in unison; the moon spins in perfect resonance with its orbit around the earth; our hearts depend on the synchronous firing of ten thousand pacemaker cells. While the forces that synchronize the flashing of fireflies may seem to have nothing to do with our heart cells, there is in fact a deep connection. Synchrony is a science in its infancy, and Strogatz is a pioneer in this new frontier in which mathematicians and physicists attempt to pinpoint just how spontaneous order emerges from chaos. From underground caves in Texas where a French scientist spent six months alone tracking his sleep-wake cycle, to the home of a Dutch physicist who in 1665 discovered two of his pendulum clocks swinging in perfect time, this fascinating book spans disciplines, continents, and centuries. Engagingly written for readers of books such as Chaos and The Elegant Universe, Sync is a tour-de-force of nonfiction writing.

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### **THE MATHEMATICS OF MARRIAGE**

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## **DYNAMIC NONLINEAR MODELS**

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**MIT Press** Divorce rates are at an all-time high. But without a theoretical understanding of the processes related to marital stability and dissolution, it is difficult to design and evaluate new marriage interventions. The **Mathematics of Marriage** provides the foundation for a scientific theory of marital relations. The book does not rely on metaphors, but develops and applies a mathematical model using difference equations. The work is the fulfillment of the goal to build a mathematical framework for the general system theory of families first suggested by Ludwig Von Bertalanffy in the 1960s. The book also presents a complete introduction to the mathematics involved in theory building and testing, and details the development of experiments and models. In one "marriage experiment," for example, the authors explored the effects of lowering or raising a couple's heart rates. Armed with their mathematical model, they were able to do real experiments to determine which processes were affected by their interventions. Applying ideas such as phase space, null clines, influence functions, inertia, and uninfluenced and influenced stable steady states (attractors), the authors show how other researchers can use the methods to weigh their own data with positive and negative weights. While the focus is on modeling marriage, the techniques can be applied to other types of psychological phenomena as well.

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## **CHAOS, FRACTALS, AND DYNAMICS**

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### **COMPUTER EXPERIMENTS IN MATHEMATICS**

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**Addison Wesley Publishing Company** Introduces the mathematical topics of chaos, fractals, and dynamics using a combination of hands-on computer experimentation and precalculus mathematics. A series of experiments produce fascinating computer graphics images of Julia sets, the Mandelbrot set, and fractals. The basic ideas of dynamics--chaos, iteration, and stability--are illustrated via computer projects.

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## **A FIRST COURSE IN CHAOTIC DYNAMICAL SYSTEMS**

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### **THEORY AND EXPERIMENT**

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**CRC Press** **A First Course in Chaotic Dynamical Systems: Theory and Experiment** is the first book to introduce modern topics in dynamical systems at the undergraduate level. Accessible to readers with only a background in calculus, the book integrates both theory and computer experiments into its coverage of contemporary ideas in dynamics. It is designed as a gradual introduction to the basic mathematical ideas behind such topics as chaos, fractals, Newton's method, symbolic dynamics, the Julia set, and the Mandelbrot set, and includes biographies of some of the leading researchers in the field of dynamical systems. Mathematical and computer experiments are integrated throughout the text to help illustrate

the meaning of the theorems presented. Chaotic Dynamical Systems Software, Labs 1-6 is a supplementary laboratory software package, available separately, that allows a more intuitive understanding of the mathematics behind dynamical systems theory. Combined with A First Course in Chaotic Dynamical Systems, it leads to a rich understanding of this emerging field.

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## **NONLINEAR TIME SERIES ANALYSIS**

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Cambridge University Press **Sample Text**

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## **NONLINEAR DYNAMICS**

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## **A TWO-WAY TRIP FROM PHYSICS TO MATH**

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Routledge **Nonlinear Dynamics: A Two-Way Trip from Physics to Math** provides readers with the mathematical tools of nonlinear dynamics to tackle problems in all areas of physics. The selection of topics emphasizes bifurcation theory and topological analysis of dynamical systems. The book includes real-life problems and experiments as well as exercises and work

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## **NONLINEAR DYNAMICS AND CHAOS**

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## **A FIRST COURSE IN DYNAMICS**

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## **WITH A PANORAMA OF RECENT DEVELOPMENTS**

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Cambridge University Press **The theory of dynamical systems is a major mathematical discipline closely intertwined with all main areas of mathematics. It has greatly stimulated research in many sciences and given rise to the vast new area variously called applied dynamics, nonlinear science, or chaos theory. This introduction for senior undergraduate and beginning graduate students of mathematics, physics, and engineering combines mathematical rigor with copious examples of important applications. It covers the central topological and probabilistic notions in dynamics ranging from Newtonian mechanics to coding theory. Readers need not be familiar with manifolds or measure theory; the only prerequisite is a basic undergraduate analysis course. The authors begin by describing the wide array of scientific and mathematical questions that dynamics can address. They then use a progression of examples to present the concepts and tools for describing asymptotic behavior in dynamical systems, gradually increasing the level of complexity. The final chapters introduce modern developments and applications of dynamics. Subjects include contractions, logistic maps, equidistribution, symbolic dynamics, mechanics, hyperbolic dynamics, strange attractors, twist maps, and KAM-theory.**