Differential Equations And Dynamical Systems Chgplc

This book is a mathematically rigorous introduction to the beautiful subject of ordinary differential equations for beginning graduate or advanced undergraduate students. Students should have a solid background in analysis and linear algebra. The presentation emphasizes commonly used techniques without necessarily striving for completeness or for the treatment of a large number of topics. The first half of the book is devoted to the development of the basic theory: linear systems, existence and uniqueness of solutions to the initial value problem, flows, stability, and smooth dependence of solutions upon initial conditions and parameters. Much of this theory also serves as the paradigm for evolutionary partial differential equations. The second half of the book is devoted to geometric theory: topological conjugacy, invariant manifolds, existence and stability of periodic solutions, bifurcations, normal forms, and the existence of transverse homoclinic points and their link to chaotic dynamics. A common thread throughout the second part is the use of the implicit function theorem in Banach space. Chapter 5, devoted to this topic, the serves as the bridge between the two halves of the book.

This book provides a self-contained introduction to ordinary differential equations and dynamical systems suitable for beginning graduate students. The first part begins with some simple examples of explicitly solvable equations and a first glance at qualitative methods. Then the fundamental results concerning the initial value problem are proved: existence, uniqueness, extensibility, dependence on initial conditions. Furthermore, linear equations are considered, including the Floquet theorem, and some perturbation results. As somewhat independent topics, the Frobenius method for linear equations in the complex domain is established and Sturm-Liouville boundary value problems, including oscillation theory, are investigated. The second part introduces the concept of a dynamical system. The Poincare-Bendixson theorem is proved, and several examples of planar systems from classical mechanics, ecology, and electrical engineering are investigated. Moreover, attractors, Hamiltonian systems, the KAM theorem, and periodic solutions are discussed. Finally, stability is studied, including the stable manifold and the Hartman-Grobman theorem for both continuous and discrete systems. The third part introduces chaos, beginning with the basics for iterated interval maps and ending with the Smale-Birkhoff theorem and the Melnikov method for homoclinic orbits. The text contains almost three hundred exercises. Additionally, the use of mathematical software systems is incorporated throughout, showing how they can help in the study of differential equations.

* Introduces a state-of-the-art method for the study of the asymptotic behavior of solutions to evolution partial differential equations. * Written by established mathematicians at the forefront of their field, this blend of delicate analysis and broad

application is ideal for a course or seminar in asymptotic analysis and nonlinear PDEs. * Well-organized text with detailed index and bibliography, suitable as a course text or reference volume.

Mathematicians often face the question to which extent mathematical models describe processes of the real world. These models are derived from experimental data, hence they describe real phenomena only approximately. Thus a mathematical approach must begin with choosing properties which are not very sensitive to small changes in the model, and so may be viewed as properties of the real process. In particular, this concerns real processes which can be described by means of ordinary differential equations. By this reason different notions of stability played an important role in the qualitative theory of ordinary differential equations commonly known nowdays as the theory of dynamical systems. Since physical processes are usually affected by an enormous number of small external fluctuations whose resulting action would be natural to consider as random, the stability of dynamical systems with respect to random perturbations comes into the picture. There are differences between the study of stability properties of single trajectories, i. e. , the Lyapunov stability, and the global stability of dynamical systems. The stochastic Lyapunov stability was dealt with in Hasminskii [Has]. In this book we are concerned mainly with questions of global stability in the presence of noise which can be described as recovering parameters of dynamical systems from the study of their random perturbations. The parameters which is possible to obtain in this way can be considered as stable under random perturbations, and so having physical sense. -1- Our set up is the following.

Ordinary Differential Equations

Nonautonomous Dynamics

Dynamical Systems with Applications Using Mathematica®

A Dynamical Systems Approach. Part II: Higher Dimensional Systems

A Stability Technique for Evolution Partial Differential Equations

This corrected third printing retains the authors'main emphasis on ordinary differential equations. It is most appropriate for upper level undergraduate and graduate students in the fields of mathematics, engineering, and applied mathematics, as well as the life sciences, physics and economics. The authors have taken the view that a differential equations theory defines functions; the object of the theory is to understand the behaviour of these functions. The tools the authors use include qualitative and numerical methods besides the traditional analytic methods, and the companion software, MacMath, is designed to bring these notions to life.

Mathematics is playing an ever more important role in the physical and biological sciences, provoking a blurring of boundaries between scientific disciplines and a resurgence bf interest in the modern as well as the clas sical techniques of applied *mathematics. This renewal of interest, both in research and teaching, has led to the establishment of the series: Texts in Applied Mat!!ematics (TAM). The development of new courses is a natural consequence of a high level of excitement oil the research frontier as newer techniques, such as numerical and symbolic cotnputer systems, dynamical systems, and chaos, mix with and reinforce the traditional methods of applied mathematics. Thus, the purpose of this textbook series is to meet the current and future needs of these advances and encourage the teaching of new courses. TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses, and will complement the Applied Math ematical Sciences (AMS) series, which will focus on advanced textbooks and research level monographs. Preface to the Second Edition This book covers those topics necessary for a clear understanding of the qualitative theory of ordinary differential equations and the concept of a dynamical system. It is written for advanced undergraduates and for beginning graduate students. It begins with a study of linear systems of ordinary differential equations, a topic already familiar to the student who has completed a first course in differential equations.*

A pioneer in the field of dynamical systems discusses one-dimensional dynamics, differential equations, random walks, iterated function systems, symbolic dynamics, and Markov chains. Supplementary materials include PowerPoint slides and MATLAB exercises. 2010 edition.

This text is about the dynamical aspects of ordinary differential equations and the relations between dynamical systems and certain fields outside pure mathematics. It is an update of one of Academic Press's most successful mathematics texts ever published, which has become the standard textbook for graduate courses in this area. The authors are tops in the field of advanced mathematics. Steve Smale is a Field's Medalist, which equates to being a Nobel prize winner in mathematics. Bob Devaney has authored several leading books in this subject area. Linear algebra prerequisites toned down from first edition Inclusion of analysis of examples of chaotic systems, including Lorenz, Rosssler, and Shilnikov systems Bifurcation theory included throughout.

Nonlinear Differential Equations and Dynamical Systems

Analytical Methods

Data-Driven Science and Engineering

Principles of Discontinuous Dynamical Systems

Differential Equations: From Calculus to Dynamical Systems: Second Edition

Non-Linear Differential Equations and Dynamical Systems is the second book within Ordinary Differential Equations with Applications to Trajectories and Vibrations, Six-volume Set. As a set, they are the fourth volume in the series Mathematics and Physics Applied to Science and Technology. This second book consists of two chapters (chapters 3 and 4 of the set). The first chapter considers non-linear differential equations of first order, including variable coefficients.

A first-order differential equation is equivalent to a first-order differential in two variables. The differentials of order higher than the first and with more than two variables are also considered. The applications include the representation of vector fields by potentials. The second chapter in the book starts with linear oscillators with coefficients varying with time, including parametric resonance. It proceeds to non-linear oscillators including non-linear resonance, amplitude jumps, and hysteresis. The non-linear restoring and friction forces also apply to electromechanical dynamos. These are examples of dynamical systems with bifurcations that may lead to chaotic motions. Presents general first-order differential equations including non-linear like the Ricatti equation Discusses differentials of the first or higher order in two or more variables Includes discretization of differential equations as finite difference equations Describes parametric resonance of linear time dependent oscillators specified by the Mathieu functions and other methods Examines non-linear oscillations and damping of dynamical systems including bifurcations and chaotic motions

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.

This is a continuation of the subject matter discussed in the first book, with an emphasis on systems of ordinary differential equations and will be most appropriate for upper level undergraduate and graduate students in the fields of mathematics, engineering, and applied mathematics, as well as in the life sciences, physics, and economics. After an introduction, there follow chapters on systems of differential equations, of linear differential equations, and of nonlinear differential equations. The book continues with structural stability, bifurcations, and an appendix on linear algebra. The whole is rounded off with an appendix containing important theorems from parts I and II, as well as answers to selected problems.

The first systematic presentation of the theory of dynamical systems under the influence of randomness, this book includes products of random mappings as well as random and stochastic differential equations. The basic multiplicative ergodic theorem is presented, providing a random substitute for linear algebra. On its basis, many applications are detailed. Numerous instructive examples are treated analytically or numerically.

Dynamical Systems and Numerical Analysis

Part 1

A Dynamical Systems Approach

Seminar on Differential Equations and Dynamical Systems

Ordinary Differential Equations and Smooth Dynamical Systems

From the reviews: "The reading is very easy and pleasant for the non-mathematician, which is really noteworthy. The two chapters enunciate the basic principles of the field, ... indicate connections with other fields of mathematics and sketch the motivation behind the various concepts which are introduced.... What is particularly pleasant is the fact that the authors are quite successful in giving to the reader the feeling behind the demonstrations which are sketched. Another point to notice is the existence of an annotated extended bibliography and a very complete index. This really enhances the value of this book

and puts it at the level of a particularly interesting reference tool. I thus strongly recommend to buy this very interesting and stimulating book." Journal de Physique

This textbook offers a foundation for a first course in differential equations, covering traditional areas in addition to topics such as dynamical systems. Numerical methods and problem-solving techniques are emphasized throughout the text. Discussion of computer use (Mathematica and Maple) is also included where appropriate, and where individual exercises are marked with an icon, they are best solved with the help of a computer or calculator.

This text discusses the qualitative properties of dynamical systems including both differential equations and maps. The approach taken relies heavily on examples (supported by extensive exercises, hints to solutions and diagrams) to develop the material, including a treatment of chaotic behavior. The unprecedented popular interest shown in recent years in the chaotic behavior of discrete dynamic systems including such topics as chaos and fractals has had its impact on the undergraduate and graduate curriculum. However there has, until now, been no text which sets out this developing area of mathematics *within the context of standard teaching of ordinary differential equations. Applications in physics, engineering, and geology are considered and introductions to fractal imaging and cellular automata are given.*

Discontinuous dynamical systems have played an important role in both theory and applications during the last several decades. This is still an area of active research and techniques to make the applications more effective are an ongoing topic of interest. Principles of Discontinuous Dynamical Systems is devoted to the theory of differential equations with variable moments of impulses. It introduces a new strategy of implementing an equivalence to systems whose solutions have prescribed moments of impulses and utilizing special topologies in spaces of piecewise continuous functions. The achievements obtained on the basis of this approach are described in this book. The text progresses systematically, by covering preliminaries in the first four chapters. This is followed by more complex material and special topics such as Hopf bifurcation, Devaney's chaos, and the shadowing property are discussed in the last two chapters. This book is suitable for researchers and graduate *students in mathematics and also in diverse areas such as biology, computer science, and engineering who deal with real world problems.*

Nonlinear Oscillations and Global Attractors

An Introduction to Dynamical Systems

Global Bifurcations and Chaos

Dynamical Systems, and Control Science: Lecture Notes in Pure and Applied Mathematics Series/152

Theory and Applications

Many textbooks on differential equations are written to be interesting to the teacher rather than the student. Introduction to Differential Equations with Dynamical Systems is directed toward students. This concise and up-to-date textbook addresses the challenges that undergraduate mathematics, engineering, and science students experience during a first course on differential equations. And, while covering all the standard parts of the subject, the book emphasizes linear constant coefficient equations and applications, including the topics essential to engineering students. Stephen Campbell and Richard Haberman--using carefully worded derivations, elementary explanations, and examples, exercises, and figures rather than theorems and proofs--have written a book that makes learning and

teaching differential equations easier and more relevant. The book also presents elementary dynamical systems in a unique and flexible way that is suitable for all courses, regardless of length.
A thoroughly modern textbook for the sophomore-level differential equations course. The examples and exercises emphasize modeling not only in engineering and physics but also in applied mathematics and biology. There is an early introduction to numerical methods and, throughout, a strong emphasis on the qualitative viewpoint of dynamical systems. Bifurcations and analysis of parameter variation is a persistent theme. Presuming previous exposure to only two semesters of calculus, necessary linear algebra is developed as needed. The exposition is very clear and inviting. The book would serve well for use in a flipped-classroom pedagogical approach or for self-study for an advanced undergraduate or beginning graduate student. This second edition of Noonburg's best-selling textbook includes two new chapters on partial differential equations, making the book usable for a two-semester sequence in differential equations. It includes exercises, examples, and extensive student projects taken from the current mathematical and scientific literature.
The first three chapters contain the elements of the theory of dynamical systems and the numerical solution of initial-value

problems. In the remaining chapters, numerical methods are formulated as dynamical systems and the convergence and stability properties of the methods are examined.

This Special Edition contains new results on Differential and Integral Equations and Systems, covering higher-order Initial and Boundary Value Problems, fractional differential and integral equations and applications, non-local optimal control, inverse, and higher-order nonlinear boundary value problems, distributional solutions in the form of a finite series of the Dirac delta function and its derivatives, asymptotic properties' oscillatory theory for neutral nonlinear differential equations, the existence of extremal solutions via monotone iterative techniques, predator–prey interaction via fractional-order models, among others. Our main goal is not only to show new trends in this field but also to showcase and provide new methods and techniques that can lead to future research.

Differential Equations

Dynamical Systems

Differential Equations and Dynamical Systems

Machine Learning, Dynamical Systems, and Control

Non-Linear Differential Equations and Dynamical Systems

This book is about dynamical aspects of ordinary differential equations and the relations between dynamical systems and certain fields outside pure mathematics. A prominent role is played by the structure theory of linear operators on finite-dimensional vector spaces; the authors have included a self-contained treatment of that subject.

Global Bifurcations and Chaos: Analytical Methods is unique in the literature of chaos in that it not only defines the concept of chaos in deterministic systems, but it describes the mechanisms which give rise to chaos (i.e., homoclinic and heteroclinic motions) and derives explicit techniques whereby these mechanisms can be detected in specific systems. These techniques can be viewed as generalizations of Melnikov's method to multi-degree of freedom systems subject to slowly varying parameters and quasiperiodic excitations. A unique feature of the book is that each theorem is illustrated with drawings that enable the reader to build visual pictures of global dynamcis of the systems being described. This approach leads to an enhanced intuitive understanding of the theory.

Although this systematic study of autonomous systems begins with a thorough treatment of linear systems, the main emphasis is on local and global behavior of nonlinear systems. The main purpose of this revised edition is to introduce students to the qualitative and geometric theory of ordinary differential equations as well as serving as a reference book for mathematicians researching dynamical systems. Readers will find that, except for certain topics of current mathematical research, such as the number of limit cycles and the nature of attracting sets of dynamical systems, the global qualitative theory of a nonlinear dynamical system leads to an understanding of the solution set of the nonlinear system to rival that which we have of linear flows.

This volume contains contributed papers authored by participants of a Conference on Differential Equations and Dynamical Systems which was held at the Instituto Superior Tecnico (Lisbon, Portugal). The conference brought together a large number of specialists in the area of differential equations and dynamical systems and provided an opportunity to celebrate Professor Waldyr Oliva's 70th birthday, honoring his fundamental contributions to the field. The volume constitutes an overview of the current research over a wide range of topics, extending from qualitative theory for (ordinary, partial or functional) differential equations to hyperbolic dynamics and ergodic theory.

Discrete Dynamical Systems and Difference Equations with Mathematica

Differential Dynamical Systems, Revised Edition

Differential Equations: A Dynamical Systems Approach

Ordinary Differential Equations and Dynamical Systems

Data-driven discovery is revolutionizing the modeling, prediction, and control of complex systems. This textbook brings together machine learning, engineering mathematics, and mathematical physics to integrate modeling and control of dynamical systems with modern

methods in data science. It highlights many of the recent advances in scientific computing that enable data-driven methods to be applied to a diverse range of complex systems, such as turbulence, the brain, climate, epidemiology, finance, robotics, and autonomy. Aimed at advanced undergraduate and beginning graduate students in the engineering and physical sciences, the text presents a range of topics and methods from introductory to state of the art.

Differential Equations and Dynamical SystemsSpringer Science & Business Media

Hirsch, Devaney, and Smale’s classic Differential Equations, Dynamical Systems, and an Introduction to Chaos has been used by professors as the primary text for undergraduate and graduate level courses covering differential equations. It provides a theoretical approach to dynamical systems and chaos written for a diverse student population among the fields of mathematics, science, and engineering. Prominent experts provide everything students need to know about dynamical systems as students seek to develop sufficient mathematical skills to analyze the types of differential equations that arise in their area of study. The authors provide rigorous exercises

and examples clearly and easily by slowly introducing linear systems of differential equations. Calculus is required as specialized advanced topics not usually found in elementary differential equations courses are included, such as exploring the world of discrete dynamical systems and describing chaotic systems. Classic text by three of the world's most prominent mathematicians Continues the tradition of expository excellence Contains updated material and expanded applications for use in applied studies

Dynamic tools of analysis and modelling are increasingly used in Economics and Biology and have become more and more sophisticated in recent years, to the point where the general students without training in Dynamic Systems (DS) would be at a loss. No doubt they are referred to the original sources of mathematical theorems used in the various proofs, but the level of mathematics is generally beyond them. Students are thus left with the burden of somehow understanding advanced mathematics by themselves, with· very little help. It is to these general students, equipped only with a modest background of Calculus and Matrix Algebra that this book is dedicated. It aims at providing them with a fairly comprehensive box

of dynamical tools they are expected to have at their disposal. The first three Chapters start with the most elementary notions of first and second order Differential and Difference Equations. For these, no matrix theory and hardly any calculus are needed. Then, before embarking on linear and nonlinear DS, a review of some Linear Algebra in Chapter 4 provides the bulk of matrix theory required for the study of later Chapters. Systems of Linear Differ ential Equations (Ch. 5) and Difference Equations (Ch. 6) then follow to provide students with a good background in linear DS, necessary for the subsequent study of nonlinear systems. Linear Algebra, reviewed in Ch. 4, is used freely in these and subsequent chapters to save space and time.

Random Perturbations of Dynamical Systems

A Dynamical Systems Approach to Theory and Practice

Differential Equations, Dynamical Systems, and an Introduction to Chaos

Differential Equations, Dynamical Systems, and Linear Algebra

Approaches To The Qualitative Theory Of Ordinary Differential Equations: Dynamical Systems And Nonlinear Oscillations

Bridging the gap between elementary courses and the research literature in this field, the book covers the basic concepts necessary to study differential equations. Stability theory is developed, starting with linearisation methods going back to Lyapunov and Poincaré, before moving on to the global direct method. The Poincaré-Lindstedt method is introduced to approximate periodic solutions, while at the same time proving existence by the implicit function theorem. The final part covers relaxation oscillations, bifurcation theory, centre manifolds, chaos in mappings and differential equations, and Hamiltonian systems. The subject material is presented from both the qualitative and the quantitative point of view, with many examples to illustrate the theory, enabling the reader to begin research after studying this book. 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.

Presents recent developments in the areas of differential equations, dynamical systems, and control of finke and infinite dimensional systems. Focuses on current trends in differential equations and dynamical system research-from Darameterdependence of solutions to robui control laws for inflnite dimensional systems.

This book emphasizes those topological methods (of dynamical systems) and theories that are useful in the study of different classes of nonautonomous evolutionary equations. The content is developed over six chapters, providing a thorough introduction to the techniques used in the Chapters III-VI described by Chapter I-II. The author gives a systematic treatment of the basic mathematical theory and constructive methods for Nonautonomous Dynamics. They show how these diverse topics are connected to other important parts of mathematics, including Topology, Functional Analysis and Qualitative Theory of Differential/Difference Equations. Throughout the book a nice balance is maintained between rigorous mathematics and applications (ordinary differential/difference equations, functional differential equations and partial difference equations). The primary readership includes graduate and PhD students and researchers in in the field of dynamical

systems and their applications (control theory, economic dynamics, mathematical theory of climate, population dynamics, oscillation theory etc).
An Introduction with Applications in Economics and Biology
Random Dynamical Systems
Dynamical Systems I
Continuous and Discrete
Introduction to Differential Equations with Dynamical Systems

This book is an ideal text for advanced undergraduate students and graduate students with an interest in the qualitative theory of ordinary differential equations and dynamical systems. Elementary knowledge is emphasized by the detailed discussions on the fundamental theorems of the Cauchy problem, fixed-point theorems (especially the twist theorems), the principal idea of dynamical systems, the nonlinear oscillation of Duffing's equation, and some special analyses of particular differential equations. It also contains the latest research by the author as an integral part of the book.

This textbook presents a systematic study of the qualitative and geometric theory of nonlinear differential equations and dynamical systems. Although the main topic of the book is the

local and global behavior of nonlinear systems and their bifurcations, a thorough treatment of linear systems is given at the beginning of the text. All the material necessary for a clear understanding of the qualitative behavior of dynamical systems is contained in this textbook, including an outline of the proof and examples illustrating the proof of the Hartman-Grobman theorem. In addition to minor corrections and updates throughout, this new edition includes materials on higher order Melnikov theory and the bifurcation of limit cycles for planar systems of differential equations.

This book provides an introduction to the theory of dynamical systems with the aid of the Mathematica® computer algebra package. The book has a very hands-on approach and takes the reader from basic theory to recently published research material. Emphasized throughout are numerous applications to biology, chemical kinetics, economics, electronics, epidemiology, nonlinear optics, mechanics, population dynamics, and neural networks. Theorems and proofs are kept to a minimum. The first section deals with continuous systems

using ordinary differential equations, while the second part is devoted to the study of discrete dynamical systems.
This graduate-level introduction to ordinary differential equations combines both qualitative and numerical analysis of solutions, in line with Poincaré's vision for the field over a century ago. Taking into account the remarkable development of dynamical systems since then, the authors present the core topics that every young mathematician of our time—pure and applied alike—ought to learn. The book features a dynamical perspective that drives the motivating questions, the style of exposition, and the arguments and proof techniques. The text is organized in six cycles. The first cycle deals with the foundational questions of existence and uniqueness of solutions. The second introduces the basic tools, both theoretical and practical, for treating concrete problems. The third cycle presents autonomous and non-autonomous linear theory. Lyapunov stability theory forms the fourth cycle. The fifth one deals with the local theory, including the Grobman–Hartman theorem and the stable manifold theorem.

The last cycle discusses global issues in the broader setting of differential equations on manifolds, culminating in the Poincaré–Hopf index theorem. The book is appropriate for use in a course or for self-study. The reader is assumed to have a basic knowledge of general topology, linear algebra, and analysis at the undergraduate level. Each chapter ends with a computational experiment, a diverse list of exercises, and detailed historical, biographical, and bibliographic notes seeking to help the reader form a clearer view of how the ideas in this field unfolded over time.

Introduction to Differential Equations and Dynamical Systems

Differential Equations, Maps, and Chaotic Behaviour

Differential Equations And Dynamical Systems, 3E

Following the work of Yorke and Li in 1975, the theory of discrete dynamical systems and difference equations developed rapidly. The applications of difference equations also grew rapidly, especially with the introduction of graphical-interface software that can plot trajectories, calculate Lyapunov exponents, plot bifurcation diagrams, and find basins of attraction. Modern computer algebra

systems have opened the door to the use of symbolic calculation for studying difference equations. This book offers an introduction to discrete dynamical systems and difference equations and presents the Dynamica software. Developed by the authors and based on Mathematica, Dynamica provides an easy-to-use collection of algebraic, numerical, and graphical tools and techniques that allow users to quickly gain the ability to: Find and classify the stability character of equilibrium and periodic points Perform semicycle analysis of solutions Calculate and visualize invariants Calculate and visualize Lyapunov functions and numbers Plot bifurcation diagrams Visualize stable and unstable manifolds Calculate Box Dimension While it presents the essential theoretical concepts and results, the book's emphasis is on using the software. The authors present two sets of Dynamica sessions: one that serves as a tutorial of the different techniques, the other features case studies of well-known difference equations. Dynamica and notebooks corresponding to particular chapters are available for download from the Internet.