Ordinary Differential Equations J K Hale

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KENDAL GAEL

Ordinary Differential Equations CRC Press Several types of differential equations, such as functional differential equation, age-structured models, transport equations, reaction-diffusion equations, and partial differential equations with delay, can be formulated as abstract Cauchy problems with non-dense domain. This monograph provides a self-contained and comprehensive presentation of the fundamental theory of non-densely defined semilinear Cauchy problems and their applications. Starting from the classical Hille-Yosida theorem, semigroup method, and spectral theory, this monograph introduces the abstract Cauchy problems with non-dense domain, integrated semigroups, the existence of integrated solutions, positivity of solutions, Lipschitz perturbation, differentiability of solutions with respect to the state variable, and time differentiability of solutions. Combining the functional analysis method and bifurcation approach in dynamical systems, then the nonlinear dynamics such as the stability of equilibria, center manifold theory, Hopf bifurcation, and normal form theory are established for abstract Cauchy problems with non-dense domain. Finally applications to functional differential equations, age-structured models, and parabolic equations are presented. This monograph will be very valuable for graduate students and researchers in the fields of abstract Cauchy problems, infinite dimensional dynamical systems, and their applications in biological, chemical, medical, and physical problems. *Delay Differential Equations and Applications* American Mathematical Soc. Features a balance between theory, proofs, and examples and provides applications across diverse fields of study Ordinary Differential Equations presents a thorough discussion of first-order differential equations and progresses to equations of higher order. The book transitions smoothly from first-order to higher-order equations, allowing readers to develop a complete understanding of the related theory. Featuring diverse and interesting applications from engineering, bioengineering, ecology, and biology, the book anticipates potential difficulties in understanding the various solution steps and provides all the necessary details. Topical coverage includes: First-Order Differential Equations Higher-Order Linear Equations Applications of Higher-Order Linear Equations Systems of Linear Differential Equations Laplace Transform Series Solutions Systems of Nonlinear Differential Equations In addition to plentiful exercises and examples throughout, each chapter concludes with a summary that outlines key concepts and techniques. The book's design allows readers to interact with the content, while hints, cautions, and emphasis are uniquely featured in the margins to further help and engage readers. Written in an accessible style that includes all needed details and steps, Ordinary Differential Equations is an excellent book for courses on the topic at the upper-undergraduate level. The book also serves as a valuable resource for professionals in the fields of engineering, physics, and mathematics who utilize differential equations in their everyday work. An Instructors Manual is available upon request. Email sfriedman@wiley.com for information. There is also a Solutions Manual available. The ISBN is 9781118398999. Coincidence Degree and Nonlinear Differential Equations John Wiley & Sons Features new results and up-to-date advances in modeling and solving differential equations Introducing the various classes of functional differential equations, Functional Differential Equations: Advances and Applications presents the needed tools and topics to study the various classes of functional differential equations and is primarily concerned with the existence, uniqueness, and estimates of solutions to specific problems. The book focuses on the general theory of functional differential equations, provides the requisite mathematical background, and details the qualitative behavior of solutions to functional differential equations. The book addresses problems of stability, particularly for ordinary differential equations in which the theory can provide models for other classes of functional differential equations, and the stability of solutions is useful for the application of results within various fields of science, engineering, and economics. Functional Differential Equations: Advances and Applications also features: • Discussions on the classes of equations that cannot be solved to the highest order derivative, and in turn, addresses existence results and behavior types • Oscillatory motion and solutions that occur in many real-world phenomena as well as in man-made machines • Numerous examples and applications with a specific focus on ordinary differential equations and functional differential equations with finite delay • An appendix that introduces generalized Fourier series and Fourier analysis after periodicity and almost periodicity • An extensive Bibliography with over 550 references that connects the presented concepts to further topical exploration Functional Differential Equations: Advances and Applications is an ideal reference for academics and practitioners in applied mathematics, engineering, economics, and physics. The book is also an appropriate textbook for graduate- and PhD-level courses in applied mathematics, differential and difference equations, differential analysis, and dynamics processes. CONSTANTIN CORDUNEANU, PhD, is Emeritus Professor in the Department of Mathematics at The University of Texas at Arlington, USA. The author of six books and over 200 journal articles, he is currently Associate Editor for seven journals; a member of the American Mathematical Society, Society for Industrial and Applied Mathematics, and the Romanian Academy; and past president of the American Romanian Academy of Arts and Sciences. YIZENG LI, PhD, is Professor in the Department of Mathematics at Tarrant County College, USA. He is a member of the Society for Industrial and Applied Mathematics. MEHRAN MAHDAVI, PhD, is Professor in the Department of Mathematics at Bowie State University, USA. The author of

numerous journal articles, he is a member of the American Mathematical Society, Society for Industrial and Applied Mathematics, and the Mathematical Association of America.

Theory of Functional Differential Equations Springer Science & Business Media

Skillfully organized introductory text examines origin of differential equations, then defines basic terms and outlines the general solution of a differential equation. Subsequent sections deal with integrating factors; dilution and accretion problems; linearization of first order systems; Laplace Transforms; Newton's Interpolation Formulas, more.

Ordinary Differential Equations with Applications Elsevier

Volterra Integral and Differential Equations

Nonlinear Functional Analysis and Differential Equations Springer Science & Business Media

In the last few decades the theory of ordinary differential equations has grown rapidly under the action of forces which have been working both from within and without: from within, as a development and deepen ing of the concepts and of the topological and analytical methods brought about by LYAPUNOV, POINCARE, BENDIXSON, and a few others at the turn of the century; from without, in the wake of the technological development, particularly in communications, servomechanisms, auto matic controls, and electronics. The early research of the authors just mentioned lay in challenging problems of astronomy, but the line of thought thus produced found the most impressive applications in the new fields. The body of research now accumulated is overwhelming, and many books and reports have appeared on one or another of the multiple aspects of the new line of research which some authors call "qualitative theory of differential equations". The purpose of the present volume is to present many of the view points and questions in a readable short report for which completeness is not claimed. The bibliographical notes in each section are intended to be a guide to more detailed expositions and to the original papers. Some traditional topics such as the Sturm comparison theory have been omitted. Also excluded were all those papers, dealing with special differential equations motivated by and intended for the applications.

Functional Differential Equations Springer

The fun and easy way to understand and solve complex equations Many of the fundamental laws of physics, chemistry, biology, and economics can be formulated as differential equations. This plain-English guide explores the many applications of this mathematical tool and shows how differential equations can help us understand the world around us. Differential Equations For Dummies is the perfect companion for a college differential equations course and is an ideal supplemental resource for other calculus classes as well as science and engineering courses. It offers step-by-step techniques, practical tips, numerous exercises, and clear, concise examples to help readers improve their differential equation-solving skills and boost their test scores.

Ordinary Differential Equations Springer

The aim here is to provide an introduction to the mathematical theory of infinite dimensional dynamical systems by focusing on a relatively simple - yet rich - class of examples, delay differential equations. This textbook contains detailed proofs and many exercises, intended both for self-study and for courses at graduate level, as well as a reference for basic results. As the subtitle indicates, this book is about concepts, ideas, results and methods from linear functional analysis, complex function theory, the qualitative theory of dynamical systems and nonlinear analysis. The book provides the reader with a working knowledge of applied functional analysis and dynamical systems.

Theory and Applications of Abstract Semilinear Cauchy Problems Springer

This volume contains papers written by participants at the Conference on Functional Differential and Difference Equations held at the Instituto Superior Técnico in Lisbon, Portugal. The conference brought together mathematicians working in a wide range of topics, including qualitative properties of solutions, bifurcation and stability theory, oscillatory behavior, control theory and feedback systems, biological models, state-dependent delay equations, Lyapunov methods, etc. Articles are written by leading experts in the field. A comprehensive overview is given of these active areas of current research. The book will be of interest to both theoretical and applied mathematical scientists.

Asymptotic Behavior and Stability Problems in Ordinary Differential Equations Springer Science & Business Media

Ordinary Differential Equations: 1971 NRL–MRC Conference provides information pertinent to the fundamental aspects of ordinary differential equations. This book covers a variety of topics, including geometric and qualitative theory, analytic theory, functional differential equation, dynamical systems, and algebraic theory. Organized into two parts encompassing 51 chapters, this book begins with an overview of the results on the existence of periodic solutions of a differential equation. This text then describes an index for the isolated invariant sets of a flow on a compact metric space, which contains exactly the information of the Morse index. Other chapters consider the studies of certain classes of equations that can be interpreted as models of biological or economic processes. This book discusses as well the absolute stability of some classes of integro-differential systems. The final chapter deals with first-order differential equations. This book is a valuable resource for mathematicians, graduate students, and research workers.

Ordinary Differential Equations and Mechanical Systems Springer Science & Business Media

International Conference on Differential Equations contains the proceedings of an International Conference on Differential Equations held at the University of Southern California, on September 3-7, 1974. The papers review advances in the qualitative-analytic theory of differential equations and highlight three broad areas: analytic theory (singular perturbations), qualitative theory (boundary value problems), and mathematical control theory (variational methods). Comprised of 82 chapters, this book begins with a discussion on continuous extensions, their construction, and their application in the theory of differential equations. The reader is then introduced to an approach to boundary control of partial differential equations based on the theory of semigroups of operators; lower closure and existence theorems in optimal control; and a nonlinear oscillation theorem. Subsequent chapters focus on matrices of rational functions; asymptotic integration of linear differential systems; solutions near bifurcated steady states; and geometric views in existence theory. This monograph will be of interest to students and instructors of mathematics.

Ordinary and Partial Differential Equations Elsevier

Abstract semilinear functional differential equations arise from many biological, chemical, and physical systems which are characterized by both spatial and temporal variables and exhibit various spatio-temporal patterns. The aim of this book is to provide an introduction of the qualitative theory and applications of these equations from the dynamical systems point of view. The required

prerequisites for that book are at a level of a graduate student. The style of presentation will be appealing to people trained and interested in qualitative theory of ordinary and functional differential equations.

Handbook of Ordinary Differential Equations American Mathematical Soc.
Provides more than 150 fully solved problems for linear partial differential equations and boundary value problems. Partial Differential Equations: Theory and Completely Solved Problems offers a modern introduction into the theory and applications of linear partial differential equations (PDEs). It is the material for a typical third year university course in PDEs. The material of this textbook has been extensively class tested over a period of 20 years in about 60 separate classes. The book is divided into two parts. Part I contains the Theory part and covers topics such as a classification of second order PDEs, physical and biological derivations of the heat, wave and Laplace equations, separation of variables, Fourier series, D'Alembert's principle, Sturm-Liouville theory, special functions, Fourier transforms and the method of characteristics. Part II contains more than 150 fully solved problems, which are ranked according to their difficulty. The last two chapters include sample Midterm and Final exams for this course with full solutions.

Ordinary Differential Equations and Dynamical Systems John Wiley & Sons
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.

International Conference on Differential Equations Springer
This book provides a crash course on various methods from the bifurcation theory of Functional Differential Equations (FDEs). FDEs arise very naturally in economics, life sciences and engineering and the study of FDEs has been a major source of inspiration for advancement in nonlinear analysis and infinite dimensional dynamical systems. The book summarizes some practical and general approaches and frameworks for the investigation of bifurcation phenomena of FDEs depending on parameters with chap. This well illustrated book aims to be self contained so the readers will find in this book all relevant materials in bifurcation, dynamical systems with symmetry, functional differential equations, normal forms and center manifold reduction. This material was used in graduate courses on functional differential equations at Hunan University (China) and York University (Canada).

Topics in Functional Differential and Difference Equations FriesenPress
Since the publication of my lecture notes, Functional Differential Equations in the Applied Mathematical Sciences series, many new developments have occurred. As a consequence, it was decided not to make a few corrections and additions for a second edition of those notes, but to present a more compre hensive theory. The present work attempts to consolidate those elements of the theory which have stabilized and also to include recent directions of research. The following chapters were not discussed in my original notes. Chapter 1 is an elementary presentation of linear differential difference equations with constant coefficients of retarded and neutral type. Chapter 4 develops the recent theory of dissipative systems. Chapter 9 is a new chapter on perturbed systems. Chapter 11 is a new presentation incorporating recent results on the existence of periodic solutions of autonomous equations. Chapter 12 is devoted entirely to neutral equations. Chapter 13 gives an introduction to the global and generic theory. There is also an appendix on the location of the zeros of characteristic polynomials. The remainder of the material has been completely revised and updated with the most significant changes occurring in Chapter 3 on the properties of solutions, Chapter 5 on stability, and Chapter lOon behavior near a periodic orbit.

Ordinary Differential Equations Academic Press
This book groups material that was used for the Marrakech 2002 School on Delay Di?erential Equations and Applications. The school was held from September 9-21 2002 at the Semlalia College of Sciences of the Cadi Ayyad University, Marrakech, Morocco. 47 participants and 15 instructors originating from 21 countries attended the school. Fin- cial limitations only allowed support for part of the people from Africa andAsiawhohadexpressedtheirinterestinth eschoolandhadhopedto come. Theschoolwassupportedby?nancementsfro mNATO-ASI(Nato advanced School), the International Centre of Pure and Applied Mat- matics (CIMPA, Nice, France) and Cadi Ayyad University. The activity of the school consisted in courses, plenary lectures (3) and communi- tions (9), from Monday through Friday, 8. 30 am to 6. 30 pm. Courses were divided into units of 45mn duration, taught by block of two units, with a short 5mn break between two units within a block, and a 25mn break between two blocks. The school was intended for mathematicians willing to acquire some familiarity with delay di?erential equations or enhance their knowledge on this subject. The aim was indeed to extend the basic set of knowledge, including ordinary di?erential equations and semilinearevolutionequations, suchasforexamplethedi?usion-reaction equations arising in morphogenesis or the Belouzov-Zhabotinsky ch- ical reaction, and the classic approach for the resolution of these eq- tions by perturbation, to equations having in addition terms involving past values of the solution.

Handbook of Differential Equations: Ordinary Differential Equations Springer Science & Business Media
The author, Professor Kurzweil, is one of the world's top experts in the area of ordinary differential equations - a fact fully reflected in this book. Unlike many classical texts which concentrate primarily on methods of integration of differential equations, this book pursues a modern approach: the topic is discussed in full generality which, at the same time, permits us to gain a deep insight into the

theory and to develop a fruitful intuition. The basic framework of the theory is expanded by considering further important topics like stability, dependence of a solution on a parameter, Carathéodory's theory and differential relations. The book is very well written, and the prerequisites needed are minimal - some basics of analysis and linear algebra. As such, it is accessible to a wide circle of readers, in particular to non-mathematicians.
Summaries of Projects Completed Springer Science & Business Media
This book applies a step-by-step treatment of the current state-of-the-art of ordinary differential equations used in modeling of engineering systems/processes and beyond. It covers systematically ordered problems, beginning with first and second order ODEs, linear and higher-order ODEs of polynomial form, theory and criteria of similarity, modeling approaches, phase plane and phase space concepts, stability optimization and ending on chaos and synchronization. Presenting both an overview of the theory of the introductory differential equations in the context of applicability and a systematic treatment of modeling of numerous engineering and physical problems through linear and non-linear ODEs, the volume is self-contained, yet serves both scientific and engineering interests. The presentation relies on a general treatment, analytical and numerical methods, concrete examples and engineering intuition. The scientific background used is well balanced between elementary and advanced level, making it as a unique self-contained source for both theoretically and application oriented graduate and doctoral students, university teachers, researchers and engineers of mechanical, civil and mechatronic engineering.
Bifurcation Theory of Functional Differential Equations Springer
Most mathematicians, engineers, and many other scientists are well-acquainted with theory and application of ordinary differential equations. This book seeks to present Volterra integral and functional differential equations in that same framwork, allowing the readers to parlay their knowledge of ordinary differential equations into theory and application of the more general problems. Thus, the presentation starts slowly with very familiar concepts and shows how these are generalized in a natural way to problems involving a memory. Liapunov's direct method is gently introduced and applied to many particular examples in ordinary differential equations, Volterra integro-differential equations, and functional differential equations. By Chapter 7 the momentum has built until we are looking at problems on the frontier. Chapter 7 is entirely new, dealing with fundamental problems of the resolvent, Floquet theory, and total stability. Chapter 8 presents a solid foundation for the theory of functional differential equations. Many recent results on stability and periodic solutions of functional differential equations are given and unsolved problems are stated. Smooth transition from ordinary differential equations to integral and functional differential equations Unification of the theories, methods, and applications of ordinary and functional differential equations Large collection of examples of Liapunov functions Description of the history of stability theory leading up to unsolved problems Applications of the resolvent to stability and periodic problems