Nonlinear Partial Differential Equations In Engineering And Applied Science Lecture Notes In Pure And Applied Mathematics

The lecture courses of the CIME Summer School on Probabilistic Models for Nonlinear PDE's and their Numerical Applications (April 1995) had a three-fold emphasis: first, on the weak convergence of stochastic integrals; second, on the probabilistic interpretation and the particle approximation of equations coming from Physics (conservation laws, Boltzmann-like and Navier-Stokes equations); third, on the modelling of networks by interacting particle systems. This book, collecting the notes of these courses, will be useful to probabilists working on stochastic particle methods and on the approximation of SPDEs, in particular, to PhD students and young researchers.

Exact Solutions and Invariant Subspaces of Nonlinear Partial Differential Equations in Mechanics and Physics is the first book to provide a systematic construction of exact solutions via linear invariant subspaces for nonlinear differential operators. Acting as a guide to nonlinear evolution equations and models from physics and mechanics, the book focuses on the existence of new exact solutions on linear invariant subspaces for nonlinear operators and their crucial new properties. This practical reference deals with various partial differential equations (PDEs) and models that exhibit some common nonlinear invariant features. It begins with classical as well as more recent examples of solutions on invariant subspaces. In the remainder of the book, the authors develop several techniques for constructing exact solutions of various nonlinear PDEs, including reaction-diffusion and gas dynamics models, thin-film and Kuramoto-Sivashinsky equations, nonlinear dispersion (compacton) equations, KdV-type and Harry Dym models, quasilinear magma equations, and Green-Naghdi equations. Using exact solutions, they describe the evolution properties of blow-up or extinction phenomena, finite interface propagation, and the oscillatory, changing sign behavior of weak solutions near interfaces for nonlinear PDEs of various types and orders. The techniques surveyed in Exact Solutions and Invariant Subspaces of Nonlinear Partial Differential Equations in Mechanics and Physics serve as a preliminary introduction to the general theory of nonlinear evolution PDEs of different orders and types.

This volume consists of the proceedings of the conference on Physical Mathematics and Nonlinear Partial Differential Equations held at West Virginia University in Morgantown. It describes some work dealing with weak limits of solutions to nonlinear systems of partial differential equations.

The third of three volumes on partial differential equations, this is devoted to nonlinear PDE. It treats a number of equations of classical continuum mechanics, including relativistic versions, as well as various equations arising in differential geometry, such as in the study of minimal surfaces, isometric imbedding, conformal deformation, harmonic maps, and prescribed Gauss curvature. In addition, some nonlinear diffusion problems are studied. It also introduces such analytical tools as the theory of L Sobolev spaces, H lder spaces, Hardy spaces, and Morrey spaces, and also a development of Calderon-Zygmund theory and paradifferential operator calculus. The book is aimed at graduate students in mathematics, and at professional mathematicians with an interest in partial differential equations, mathematical physics, differential geometry, harmonic analysis and complex analysis

An Introduction to Nonlinear Partial Differential Equations is a textbook on nonlinear partial differential equations. It is technique oriented with an emphasis on applications and is designed to build a foundation for studying advanced treatises in the field. The Second Edition features an updated bibliography as well as an increase in the number of exercises. All software references have been updated with the latest version of MATLAB@, the corresponding graphics have also been updated using MATLAB@. An increased focus on hydrogeology...

This is an introduction to methods for solving nonlinear partial differential equations (NLPDEs). After the introduction of several PDEs drawn from science and engineering, the reader is introduced to techniques used to obtain exact solutions of NPDEs. The chapters include the following topics: Compatibility, Differential Substitutions, Point and Contact Transformations, First Integrals, and Functional Separability. The reader is guided through these chapters and is provided with several detailed examples. Each chapter ends with a series of exercises illustrating the material presented in each chapter. The book can be used as a textbook for a second course in PDEs (typically found in both science and engineering programs) and has been used at the University of Central Arkansas for more than ten years.

What distinguishes differential geometry in the last half of the twentieth century from its earlier history is the use of nonlinear partial differential equations in the study of curved manifolds, submanifolds, mapping problems, and function theory on manifolds, among other topics. The differential equations appear as tools and as objects of study, with analytic and geometric advances fueling each other in the current explosion of progress in this area of geometry in the last twenty years. This book contains lecture notes of minicourses at the Regional Geometry Institute at Park City, Utah, in July 1992. Presented here are surveys of breaking developments in a number of areas of nonlinear partial differential equations in differential geometry. The authors of the articles are not only excellent expositors, but are also leaders in this field of research. All of the articles provide in-depth treatment of the topics and require few prerequisites and less background than current research articles.

This expanded and revised second edition is a comprehensive and systematic treatment of linear and nonlinear partial differential equations and their varied applications. Building upon the successful material of the first book, this edition contains updated modern examples and applications from diverse fields. Methods and properties of solutions, along with their physical significance, help make the book more useful for a diverse readership. The book is an exceptionally complete text/reference for graduates, researchers, and professionals in mathematics, physics, and engineering.

This volume contains the proceedings of a NATO/London Mathematical Society Advanced Study Institute held in Oxford from 25 July - 7 August 1982. The institute concerned the theory and applications of systems of nonlinear partial differential equations, with emphasis on techniques appropriate to systems of more than one equation. Most of the lecturers and participants were analysts specializing in partial differential equations, but also present were a number of numerical analysts, workers in mechanics, and other applied mathematicians. The organizing committee for the institute was J.M. Ball (Heriot-Watt), T.B. Benjamin (Oxford), J. Carr (Heriot-Watt), C.M. Dafermos (Brown), S. Hildebrandt (Bonn) and J.S. pym (Sheffield) . The programme of the institute consisted of a number of courses of expository lectures, together with special sessions on different topics. It is a pleasure to thank all the lecturers for the care they took in the preparation of their talks, and S.S. Antman, A.J. Chorin, J.K. Hale and J.E. Marsden for the organization of their special sessions. The institute was made possible by financial support from NATO, the London Mathematical Society, the u.S. Army Research Office, the u.S. Army European Research Office, and the u.S. National Science Foundation. The lectures were held in the Mathematical Institute of the University of Oxford, and residential accommodation was provided at Hertford College.

These two volumes of 47 papers focus on the increased interplay of theoretical advances in nonlinear hyperbolic systems, completely integrable systems, and evolutionary systems of nonlinear partial differential equations. The papers both survey recent results and indicate future research trends in these vital and rapidly developing branches of PDEs. The editor has grouped the papers loosely into the following five sections: integrable systems, hyperbolic systems, variational problems, evolutionary systems, and dispersive systems. However, the variety of the subjects discussed as well as their many interwoven trends demonstrate that it is through interactive advances that such rapid progress has occurred. These papers require a good background in partial differential equations. Many of the contributors are mathematical physicists, and the papers are addressed to mathematical physicists (particularly in perturbed integrable systems), as well as to PDE specialists and applied mathematicians in general.

The purpose of this book is to explain systematically and clearly many of the most important techniques set forth in recent years for using weak convergence methods to study nonlinear partial differential equations. This work represents an expanded version of a series of ten talks presented by the author at Loyola University of Chicago in the summer of 1988. The author surveys a wide collection of techniques for showing the existence of solutions to various nonlinear partial differential equations, especially when strong analytic estimates are unavailable. The overall guiding viewpoint is that when a sequence of approximate solutions converges only weakly, one must exploit the nonlinear structure of the PDE to justify passing to limits. The author concentrates on several areas that are rapidly developing and points to some underlying viewpoints common to them all. Among the several themes in the book are the primary role of measure theory and real analysis (as opposed to functional analysis) and the continual use in diverse settings of low-amplitude, high-frequency periodic test functions to extract useful information. The author uses the simplest problems possible to illustrate various key techniques. Aimed at research mathematicians in the field of nonlinear PDEs, this book should prove an important resource for understanding the techniques being used in this important area of research.

The objectives of this monograph are to present some topics from the theory of monotone operators and nonlinear semigroup theory which are directly applicable to the existence and uniqueness theory of initial-boundary-value problems for partial differential equations and to construct such operators as realizations of those problems in appropriate function spaces. A highlight of this presentation is the large number and variety of examples introduced to illustrate the connection between the theory of nonlinear operators and partial differential equations. These include primarily semilinear or quasilinear equations of elliptic or of parabolic type, degenerate cases with change of type, related systems and variational inequalities, and spatial boundary conditions of the usual Dirichlet, Neumann, Robin or dynamic type. The discussions of evolution equations include the usual initial-value problems as well as periodic or more general nonlocal constraints, history-value problems, those which may change type due to a possibly vanishing coefficient of the time derivative, and other implicit evolution equations or systems including hysteresis models. The scalar conservation law and semilinear wave equations are briefly mentioned, and hyperbolic systems arising from vibrations of elastic-plastic rods are developed. The origins of a representative sample of such problems are given in the appendix.

In recent years, the Fourier analysis methods have expereinced a growing interest in the study of partial differential equations. In particular, those techniques based on the Littlewood-Paley decomposition have proved to be very efficient for the study of evolution equations. The present book aims at presenting self-contained, state- of- the- art models of those techniques with applications to different classes of partial differential equations: transport, heat, wave and Schrödinger equations. It also offers more sophisticated models originating from fluid mechanics (in particular the incompressible and compressible Navier-Stokes equations) or general relativity. It is either directed to anyone with a good undergraduate level of knowledge in analysis or useful for experts who are eager to know the benefit that one might gain from Fourier analysis when dealing with nonlinear partial differential equations.

The book covers several topics of current interest in the field of nonlinear partial differential equations and their applications to the physics of continuous media and particle interactions. It treats the quasigeostrophic equation, integral diffusions, periodic Lorentz gas, Boltzmann equation, and critical dispersive nonlinear Schrödinger and wave equations. The book describes in a careful and expository manner several powerful methods from recent top research articles.

The aim of this book is to put together all the results that are known about the existence of formal, holomorphic and singular solutions of singular non linear partial differential equations.

The revised and enlarged third edition of this successful book presents a comprehensive and systematic treatment of linear and nonlinear partial differential equations and their varied and updated applications. In an effort to make the book more useful for a diverse readership, updated modern examples of applications are chosen from areas of fluid dynamics, gas dynamics, plasma physics, nonlinear dynamics, quantum mechanics, nonlinear optics, acoustics, and wave propagation. Nonlinear Partial Differential Equations for Scientists and Engineers, Third Edition, improves on an already highly complete and accessible resource for graduate students and professionals in mathematics, physics, science, and engineering. It may be used to great effect as a course textbook, research reference, or self-study guide.

The Handbook of Nonlinear Partial Differential Equations is the latest in a series of acclaimed handbooks by these authors and presents exact solutions of more than 1600 nonlinear equations encountered in science and engineering--many more than any other book available. The equations include those of parabolic, hyperbolic, elliptic and other types, and the authors pay special attention to equations of general form that involve arbitrary functions. A supplement at the end of the book discusses the classical and new methods for constructing exact solutions to nonlinear equations. To accommodate different mathematical backgrounds, the authors avoid wherever possible the use of special terminology, outline some of the methods in a schematic, simplified manner, and arrange the equations in increasing order of complexity. Highlights of the Handbook:

The description of many interesting phenomena in science and engineering leads to infinite-dimensional minimization or evolution problems that define nonlinear partial differential equations. While the development and analysis of numerical methods for linear partial differential equations is nearly complete, only few results are available in the case of nonlinear equations. This monograph devises numerical methods for nonlinear model problems arising in the mathematical description of phase transitions, large bending problems, image processing, and inelastic material behavior. For each of these problems the underlying mathematical model is discussed, the essential analytical properties are explained, and the proposed numerical method is rigorously analyzed. The practicality of the algorithms is illustrated by means of short implementations.

This book contains the written versions of lectures delivered since 1997 in the well-known weekly seminar on Applied Mathematics at the Collège de France in Paris, directed by Jacques-Louis Lions. It is the 14th and last of the series, due to the recent and untimely death of Professor Lions. The texts in this volume deal mostly with various aspects of the theory of nonlinear partial differential equations. They present both theoretical and applied results in many fields of growing importance such as Calculus of variations and optimal control, optimization, system theory and control, operations research, fluids and continuum mechanics, nonlinear dynamics, meteorology and climate, homogenization and material science, numerical analysis and scientific computations The book is of interest to everyone from postgraduate, who wishes to follow the most recent progress in these fields.

This book primarily concerns quasilinear and semilinear elliptic and parabolic partial differential equations, inequalities, and systems. The exposition quickly leads general theory to analysis of concrete equations, which have specific applications in such areas as electrically (semi-) conductive media, modeling of biological systems, and mechanical engineering. Methods of Galerkin or of Rothe are exposed in a large generality.

This is the second edition of the now definitive text on partial differential equations (PDE). It offers a comprehensive survey of modern techniques in the theoretical study of PDE with particular emphasis on nonlinear equations. Its wide scope and clear exposition make it a great text for a graduate course in PDE. For this edition, the author has made numerous changes, including a new chapter on nonlinear wave equations, more than 80 new exercises, several new sections, a significantly expanded bibliography. About the First Edition: I have used this book for both regular PDE and topics courses. It has a wonderful combination of insight and technical detail. ... Evans' book is evidence of his mastering of the field and the clarity of presentation. --Luis Caffarelli, University of Texas It is fun to teach from Evans' book. It explains many of the essential ideas and techniques of partial differential equations ... Every graduate student in analysis should read it. --David Jerison, MIT I use Partial Differential Equations to prepare my students for their Topic exam, which is a requirement before starting working on their dissertation. The book provides an excellent account of PDE's ... I am very happy with the preparation it provides my students. --Carlos Kenig, University of Chicago Evans' book has already attained the status of a classic. It is a clear choice for students just learning the subject, as well as for experts who wish to broaden their knowledge ... An outstanding reference for many aspects of the field. --Rafe Mazzeo, Stanford University

This book primarily concerns quasilinear and semilinear elliptic and parabolic partial differential equations, inequalities, and systems. The exposition leads the reader through the general theory based on abstract (pseudo-) monotone or accretive operators as fast as possible towards the analysis of concrete differential equations, which have specific applications in continuum (thermo-) mechanics of solids and fluids, electrically (semi-) conductive media, modelling of biological systems, or in mechanical engineering. Selected parts are mainly an introduction into the subject while some others form an advanced textbook. The second edition simplifies and extends the exposition at particular spots and augments the applications especially towards thermally coupled systems, magnetism, and more. The intended audience is graduate and PhD students as well as researchers in the theory of partial differential equations or in mathematical modelling of distributed parameter systems. ------ The monograph contains a wealth of material in both the abstract theory of steady-state or evolution equations of monotone and accretive type and concrete applications to nonlinear partial differential equations from mathematical modeling. The organization of the material is well done, and the presentation, although concise, is clear, elegant and rigorous. (...) this book is a notable addition to the existing literature. Also, it certainly will prove useful to engineers, physicists, biologists and other scientists interested in the analysis of (...) nonlinear differential models of the real world. (Mathematical Reviews)

Nonlinear Partial Differential Equations in Engineering

The emphasis of the book is given in how to construct different types of solutions (exact, approximate analytical, numerical, graphical) of numerous nonlinear PDEs correctly, easily, and quickly. The reader can learn a wide variety of techniques and solve numerous nonlinear PDEs included and many other differential equations, simplifying and transforming the equations and solutions, arbitrary functions and parameters, presented in the book). Numerous comparisons and relationships between various types of solutions, different methods and approaches are provided, the results obtained in Maple and Mathematica, facilitates a deeper understanding of the subject. Among a big number of CAS, we choose the two systems, Maple and Mathematica, that are used worldwide by students, research mathematicians, scientists, and engineers. As in the our previous books, we propose the idea to use in parallel both systems, Maple and Mathematica, since in many research problems frequently it is required to compare independent results obtained by using different computer algebra systems, Maple and/or Mathematica, at all stages of the solution process. One of the main points (related to CAS) is based on the implementation of a whole solution method (e.g. starting from an analytical derivation of exact governing equations, constructing discretizations and analytical formulas of a numerical method, performing numerical procedure, obtaining various visualizations, and comparing the numerical solution obtained with other types of solutions considered in the book, e.g. with asymptotic solution).

During the last few years, several fairly systematic nonlinear theories of generalized solutions of rather arbitrary nonlinear partial differential equations have emerged. The aim of this volume is to offer the reader a sufficiently detailed introduction to two of these recent nonlinear theories which have so far contributed most to the study of generalized solutions of nonlinear partial differential equations, bringing the reader to the level of ongoing research. The essence of the two nonlinear theories presented in this volume is the observation that much of the mathematics concerning existence, uniqueness regularity, etc., of generalized solutions for nonlinear partial differential equations can be reduced to elementary calculus in Euclidean spaces, combined with elementary algebra in quotient rings of families of smooth functions on Euclidean spaces, all of that joined by certain asymptotic interpretations. In this way, one avoids the complexities and difficulties of the customary functional analytic methods which would

involve sophisticated topologies on various function spaces. The result is a rather elementary yet powerful and far-reaching method which can, among others, give generalized solutions to linear and nonlinear partial differential equations previously unsolved or even unsolvable within distributions or hyperfunctions. Part 1 of the volume discusses the basic limitations of the linear theory of distributions when dealing with linear or nonlinear partial differential equations, particularly the impossibility and degeneracy results. Part 2 examines the way Colombeau constructs a nonlinear theory of generalized functions and then succeeds in proving quite impressive existence, uniqueness, regularity, etc., results concerning generalized solutions of large classes of linear and nonlinear partial differential equations. Finally, Part 3 is a short presentation of the nonlinear theory of Rosinger, showing its connections with Colombeau's theory, which it contains as a particular case.
The maximum principle induces an order structure for partial differential equations, and has become an important tool in nonlinear analysis. This book is the first of two volumes to systematically introduce the applications of order structure in certain nonlinear partial differential equation problems.The maximum principle is revisited through the use of the Krein-Rutman theorem and the principal eigenvalues. Its various versions, such as the moving plane and sliding plane methods, are applied to a variety of important problems of current interest. The upper and lower solution method, especially its weak version, is presented in its most up-to-date form with enough generality to cater for wide applications. Recent progress on the boundary blow-up problems and their applications are discussed, as well as some new symmetry and Liouville type results over half and entire spaces. Some of the results included here are published for the first time.
'Et moi ..., si j'avait su comment en reveru.r, One service mathematics has rendered the je n'y scrais point alle.' human race. It has put common sense back Jules Verne where it belongs, on the topmost shelf next to the dusty canister labelled 'discarded non The series is divergent; therefore we may be sense'. Eric T. Bell able to do something with it. o. Heaviside Mathematics is a tool for thought. A highly necessary tool in a world where both feedback and non linearities abound. Similarly, all kinds of parts of mathematics serve as tools for other parts and for other sciences. Applying a simple rewriting rule to the quote on the right above one finds such statements as: 'One service topology has rendered mathematical physics .. .'; 'One service logic has rendered com puter science .. .'; 'One service category theory has rendered mathematics .. .'. All arguably true. And all statements obtainable this way form part of the raison d'etre of this series.
This work will serve as an excellent first course in modern analysis. The main focus is on showing how self-similar solutions are useful in studying the behavior of solutions of nonlinear partial differential equations, especially those of parabolic type. This textbook will be an excellent resource for self-study or classroom use.
New to the Second Edition More than 1,000 pages with over 1,500 new first-, second-, third-, fourth-, and higher-order nonlinear equations with solutions Parabolic, hyperbolic, elliptic, and other systems of equations with solutions Some exact methods and transformations Symbolic and numerical methods for solving nonlinear PDEs with MapleTM, Mathematica®, and MATLAB® Many new illustrative examples and tables A large list of references consisting of over 1,300 sources To accommodate different mathematical backgrounds, the authors avoid wherever possible the use of special terminology. They outline the methods in a schematic, simplified manner and arrange the material in increasing order of complexity.
Nonlinear Partial Differential Equations in Engineering discusses methods of solution for nonlinear partial differential equations, particularly by using a unified treatment of analytic and numerical procedures. The book also explains analytic methods, approximation methods (such as asymptotic processes, perturbation procedures, weighted residual methods), and specific numerical procedures associated with these equations. The text presents exact methods of solution including the quasi-linear theory, the Poisson-Euler-Darboux equation, a general solution for anisentropic flow, and other solutions obtained from ad hoc assumptions. The book explores analytic methods such as an ad hoc solution from magneto-gas dynamics. Noh and Protter have found the Lagrange formulation to be a convenient vehicle for obtaining "soft" solutions of the equations of gas dynamics. The book notes that developing solutions in two and three dimensions can be achieved by employing Lagrangian coordinates. The book explores approximate methods that use analytical procedures to obtain solutions in the form of functions approximating solutions of nonlinear problems. Approximate methods include integral equations, boundary theory, maximum operation, and equations of elliptic types. The book can serve and benefit mathematicians, students of, and professors of calculus, statistics, or advanced mathematics.
In this volume are twenty-eight papers from the Conference on Nonlinear Partial Differential Equationsin Engineering and Applied Science, sponsored by the Office of Naval Research and held at the Universityof Rhode Island in June, 1979. Included are contributions from an international group of distinguishedmathematicians, scientists, and engineers coming from a wide variety of disciplines and having a commoninterest in the application of mathematics, particularly nonlinear partial differential equations, to realworld problems.The subject matter ranges from almost purely mathematical topics in numerical analysis and bifurcationtheory to a host of practical applications that involve nonlinear partial differential equations, suchas fluid dynamics, nonlinear waves, elasticity, viscoelasticity, hyperelasticity, solitons, metallurgy, shocklessairfoil design, quantum fields, and Darcy's law on flows in porous media.Non/inear Partial Differential Equations in Engineering and Applied Science focuses on a variety oftopics of specialized, contemporary concern to mathematicians, physical and biological scientists, andengineers who work with phenomena that can be described by nonlinear partial differential equations.
Addresses a class of equations central to many areas of mathematics and its applications. This book addresses a general approach that consists of the following: choose an appropriate function space, define a family of mappings, prove this family has a fixed point, and study various properties of the solution.
Nonlinear Partial Differential Equations: A Symposium on Methods of Solution is a collection of papers presented at the seminar on methods of solution for nonlinear partial differential equations, held at the University of Delaware, Newark, Delaware on December 27-29, 1965. The sessions are divided into four Symposia: Analytic Methods, Approximate Methods, Numerical Methods, and Applications. Separating 19 lectures into chapters, this book starts with a presentation of the methods of similarity analysis, particularly considering the merits, advantages and disadvantages of the methods. The subsequent chapters describe the fundamental ideas behind the methods for the solution of partial differential equation derived from the theory of dynamic programming and from finite systems of ordinary differential equations. These topics are followed by reviews of the principles to the lubrication approximation and compressible boundary-layer flow computation. The discussion then shifts to several applications of nonlinear partial differential equations, including in electrical problems, two-phase flow, hydrodynamics, and heat transfer. The remaining chapters cover other solution methods for partial differential equations, such as the synergetic approach. This book will prove useful to applied mathematicians, physicists, and engineers.

This volume contains lectures and invited papers from the Focus Program on "Nonlinear Dispersive Partial Differential Equations and Inverse Scattering" held at the Fields Institute from July 31-August 18, 2017. The conference brought together researchers in completely integrable systems and PDE with the goal of advancing the understanding of qualitative and long-time behavior in dispersive nonlinear equations. The program included Percy Deift’s Coxeter lectures, which appear in this volume together with tutorial lectures given during the first week of the focus program. The research papers collected here include new results on the focusing ?nonlinear Schrödinger (NLS) equation, the massive Thirring model, and the Benjamin-Bona-Mahoney equation as dispersive PDE in one space dimension, as well as the Kadomtsev-Petviashvili II equation, the Zakharov-Kuznetsov equation, and the Gross-Pitaevskii equation as dispersive PDE in two space dimensions. The Focus Program coincided with the fiftieth anniversary of the discovery by Gardner, Greene, Kruskal and Miura that the Korteweg-de Vries (KdV) equation could be integrated by exploiting a remarkable connection between KdV and the spectral theory of Schrodinger's equation in one space dimension. This led to the discovery of a number of completely integrable models of dispersive wave propagation, including the cubic NLS equation, and the derivative NLS equation in one space dimension and the Davey-Stewartson, Kadomtsev-Petviashvili and Novikov-Veselov equations in two space dimensions. These models have been extensively studied and, in some cases, the inverse scattering theory has been put on rigorous footing. It has been used as a powerful analytical tool to study global well-posedness and elucidate asymptotic behavior of the solutions, including dispersion, soliton resolution, and semiclassical limits.

Separation of Variables and Exact Solutions to Nonlinear PDEs is devoted to describing and applying methods of generalized and functional separation of variables used to find exact solutions of nonlinear partial differential equations (PDEs). It also presents the direct method of symmetry reductions and its more general version. In addition, the authors describe the differential constraint method, which generalizes many other exact methods. The presentation involves numerous examples of utilizing the methods to find exact solutions to specific nonlinear equations of mathematical physics. The equations of heat and mass transfer, wave theory, hydrodynamics, nonlinear optics, combustion theory, chemical technology, biology, and other disciplines are studied. Particular attention is paid to nonlinear equations of a reasonably general form that depend on one or several arbitrary functions. Such equations are the most difficult to analyze. Their exact solutions are of significant practical interest, as they are suitable to assess the accuracy of various approximate analytical and numerical methods. The book contains new material previously unpublished in monographs. It is intended for a broad audience of scientists, engineers, instructors, and students specializing in applied and computational mathematics, theoretical physics, mechanics, control theory, chemical engineering science, and other disciplines. Individual sections of the book and examples are suitable for lecture courses on partial differential equations, equations of mathematical physics, and methods of mathematical physics, for delivering special courses and for practical training.

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