

Chapter 5 Finite Difference Methods York University

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Thermomechanics of Composite Structures under High Temperatures Yu. I. Dimitrienko 2016-01-14 This pioneering book presents new models for the thermomechanical behavior of composite materials and structures taking into account internal physico-chemical transformations such as thermodecomposition, sublimation and melting at high temperatures (up to 3000 K). It is of great importance for the design of new thermostable materials and for the investigation of reliability and fire safety of composite structures. It also supports the investigation of interaction of composites with laser irradiation and the design of heat-shield systems. Structural methods are presented for calculating the effective mechanical and thermal properties of matrices, fibres and unidirectional, reinforced by dispersed particles and textile composites, in terms of properties of their constituent phases. Useful calculation methods are developed for characteristics such as the rate of thermomechanical erosion of composites under high-speed flow and the heat deformation of composites with account of chemical shrinkage. The author expansively compares modeling results with experimental data, and readers will find unique experimental results on mechanical and thermal properties of composites under temperatures up to 3000 K. Chapters show how the behavior of composite shells under high temperatures is simulated by the finite-element method and so cylindrical and axisymmetric composite shells and composite plates are investigated under local high-temperature heating. The book will be of interest to researchers and to engineers designing composite structures, and invaluable to materials scientists developing advanced performance thermostable materials.

Applied Mechanics Reviews 1970

Computational Techniques for Fluid Dynamics 1 Clive A.J. Fletcher 2012-12-06 This well-known 2-volume textbook provides senior undergraduate and postgraduate engineers, scientists and applied mathematicians with the specific techniques, and the framework to develop skills in using the techniques in the various branches of computational fluid dynamics. A solutions manual to the exercises is in preparation.

Modern Theory of Gratings Yuriy K. Sirenko 2010-07-23 The advances in the theory of diffraction gratings and the applications of these results certainly determine the progress in several areas of applied science and engineering. The polarization converters, phase shifters and filters, quantum and solid-state oscillators, open quasi optical dispersive resonators and power compressors, slow-wave structures and patter forming systems, accelerators and spectrometer; that is still far from being a complete list of devices exploiting the amazing ability of periodic structures to perform controlled frequency, spatial, and polarization selection of signals. Diffraction gratings used to be and still are one of the most popular objects of analysis in electromagnetic theory. The further development of the theory of diffraction gratings, in spite of considerable achievements, is still very important presently. The requirements of applied optics and microwave engineering present the theory of diffraction gratings with many new problems which force us to search for new methods and tools for their resolution. Just in such way there appeared recently new fields, connected with the analysis, synthesis and definition of equivalent parameters of artificial materials - layers and coatings, having periodic structure and possessing features, which can be found in natural materials only in extraordinary or exceptional situations. In this book the authors present results of the electromagnetic theory of diffraction gratings that may constitute the base of further development of this theory which can meet the challenges provided by the most recent requirements of fundamental and applied science. The following issues will be considered in the book Authentic methods of analytical regularization, that perfectly match the requirements of analysis of resonant scattering of electromagnetic waves by gratings; Spectral theory of gratings, providing a reliable foundation for the analysis of spatial - frequency transformations of electromagnetic fields occurring in open periodic resonators and waveguides; Parametric Fourier method and C-method, that are oriented towards the efficient numerical analysis of transformation properties of fields in the case of arbitrary profile periodic boundary between dielectric media and multilayered conformal arrays; Rigorous methods for analysis of transient processes and time-spatial transformations of electromagnetic waves in resonant situations, based on development and incorporation in standard numerical routines of FDTD of so called explicit absorbing boundary conditions; New approaches to the solution of homogenization problems - the key problem arising in construction of metamaterials and meta surfaces; New physical results about the resonance scattering of pulse and monochromatic waves by periodic structures, including structures with chiral or left-handed materials; Methods and the results of the solutions of several actual applied problems of analysis and synthesis of pattern creating gratings, power compressors, resonance radiators of high capacity short radio pulses, open electromagnetic structures for the systems of resonant quasi optics and absorbing coatings.

Difference Equations Ronald E. Mickens 2015-03-06 *Difference Equations: Theory, Applications and Advanced Topics, Third Edition* provides a broad introduction to the mathematics of difference equations and some of their applications. Many worked examples illustrate how to calculate both exact and approximate solutions to special classes of difference equations. Along with adding several advanced to **Physics of Nuclear Reactors** P. Mohanakrishnan 2021-05-19 *Physics of Nuclear Reactors* presents a comprehensive analysis of nuclear reactor physics. Editors P. Mohanakrishnan, Om Pal Singh, and Kannan Umasankari and a team of expert contributors combine their knowledge to guide the reader through a toolkit of methods for solving transport equations, understanding the physics of reactor design principles, and developing reactor safety strategies. The inclusion of experimental and operational reactor physics makes this a unique reference for those working and researching nuclear power and the fuel cycle in existing power generation sites and experimental facilities. The book also includes radiation physics, shielding techniques and an analysis of shield design, neutron monitoring and core operations. Those involved in the development and operation of nuclear reactors and the fuel cycle will gain a thorough understanding of all elements of nuclear reactor physics, thus enabling them to apply the analysis and solution methods provided to their own work and research. This book looks to future reactors in development and analyzes their status and challenges before providing possible worked-through solutions. Cover image: Kaiga Atomic Power Station Units 1 - 4, Karnataka, India. In 2018, Unit 1 of the Kaiga Station surpassed the world record of continuous operation, at 962 days. Image courtesy of DAE, India. Includes methods for solving neutron transport problems, nuclear cross-section data and solutions of transport theory. Dedicates a chapter to reactor safety that covers mitigation, probabilistic safety assessment and uncertainty analysis. Covers experimental and operational physics with details on noise analysis and failed fuel detection

Iterative Methods for Sparse Linear Systems Yousef Saad 2003-04-01 *Mathematics of Computing -- General*.

Handbook of Differential Equations Daniel Zwillinger 2014-05-12 *Handbook of Differential Equations, Second Edition* is a handy reference to many popular techniques for solving and approximating differential equations, including numerical methods and exact and approximate analytical methods. Topics covered range from transformations and constant coefficient linear equations to Picard iteration, along with conformal mappings and inverse scattering. Comprised of 192 chapters, this book begins with an introduction to transformations as well as general ideas about differential equations and how they are solved, together with the techniques needed to determine if a partial differential equation is well-posed or what the "natural" boundary conditions are. Subsequent sections focus on exact and approximate analytical solution techniques for differential equations, along with numerical methods for ordinary and partial differential equations. This monograph is intended for students taking courses in differential equations at either the undergraduate or graduate level, and should also be useful for practicing engineers or scientists who solve differential equations on an occasional basis.

Numerical Approximation of Partial Differential Equations Sören Bartels 2016-06-02 Finite element methods for approximating partial differential equations have reached a high degree of maturity, and are an indispensable tool in science and technology. This textbook aims at providing a thorough introduction to the construction, analysis, and implementation of finite element methods for model problems arising in continuum mechanics. The first part of the book discusses elementary properties of linear partial differential equations along with their basic numerical approximation, the functional-analytical framework

for rigorously establishing existence of solutions, and the construction and analysis of basic finite element methods. The second part is devoted to the optimal adaptive approximation of singularities and the fast iterative solution of linear systems of equations arising from finite element discretizations. In the third part, the mathematical framework for analyzing and discretizing saddle-point problems is formulated, corresponding finite element methods are analyzed, and particular applications including incompressible elasticity, thin elastic objects, electromagnetism, and fluid mechanics are addressed. The book includes theoretical problems and practical projects for all chapters, and an introduction to the implementation of finite element methods.

Computational Heat Transfer Yogesh Jaluria 2017-10-19 This new edition updated the material by expanding coverage of certain topics, adding new examples and problems, removing outdated material, and adding a computer disk, which will be included with each book. Professor Jaluria and Torrance have structured a text addressing both finite difference and finite element methods, comparing a number of applicable methods.

Ocean Acoustic Propagation by Finite Difference Methods D. Lee 2014-06-28 A concise guide to the theory and application of numerical methods for predicting ocean acoustic propagation, also providing an introduction to numerical methods, with an overview of those methods presently in use. An in-depth development of the implicit-finite-difference technique is presented together with bench-mark test examples included to demonstrate its application to realistic ocean environments. Other applications include atmospheric acoustics, plasma physics, quantum mechanics, optics and seismology.

Introduction to Difference Equations Samuel Goldberg 1958 Exceptionally clear exposition of an important mathematical discipline and its applications to sociology, economics, and psychology. Topics include calculus of finite differences, difference equations, matrix methods, and more. 1958 edition.

The Lattice Boltzmann Method Timm Krüger 2016-11-07 This book is an introduction to the theory, practice, and implementation of the Lattice Boltzmann (LB) method, a powerful computational fluid dynamics method that is steadily gaining attention due to its simplicity, scalability, extensibility, and simple handling of complex geometries. The book contains chapters on the method's background, fundamental theory, advanced extensions, and implementation. To aid beginners, the most essential paragraphs in each chapter are highlighted, and the introductory chapters on various LB topics are front-loaded with special "in a nutshell" sections that condense the chapter's most important practical results. Together, these sections can be used to quickly get up and running with the method. Exercises are integrated throughout the text, and frequently asked questions about the method are dealt with in a special section at the beginning. In the book itself and through its web page, readers can find example codes showing how the LB method can be implemented efficiently on a variety of hardware platforms, including multi-core processors, clusters, and graphics processing units. Students and scientists learning and using the LB method will appreciate the wealth of clearly presented and structured information in this volume.

Nonlinear Differential Equations in Physics Santanu Saha Ray 2019-12-28 This book discusses various novel analytical and numerical methods for solving partial and fractional differential equations. Moreover, it presents selected numerical methods for solving stochastic point kinetic equations in nuclear reactor dynamics by using Euler-Maruyama and strong-order Taylor numerical methods. The book also shows how to arrive at new, exact solutions to various fractional differential equations, such as the time-fractional Burgers-Hopf equation, the (3+1)-dimensional time-fractional Khokhlov-Zabolotskaya-Kuznetsov equation, (3+1)-dimensional time-fractional KdV-Khokhlov-Zabolotskaya-Kuznetsov equation, fractional (2+1)-dimensional Davey-Stewartson equation, and integrable Davey-Stewartson-type equation. Many of the methods discussed are analytical-numerical, namely the modified decomposition method, a new two-step Adomian decomposition method, new approach to the Adomian decomposition method, modified homotopy analysis method with Fourier transform, modified fractional reduced differential transform method (MFRDTM), coupled fractional reduced differential transform method (CFRDTM), optimal homotopy asymptotic method, first integral method, and a solution procedure based on Haar wavelets and the operational matrices with function approximation. The book proposes for the first time a generalized order operational matrix of Haar wavelets, as well as new techniques (MFRDTM and CFRDTM) for solving fractional differential equations. Numerical methods used to solve stochastic point kinetic equations, like the Wiener process, Euler-Maruyama, and order 1.5 strong Taylor methods, are also discussed.

Theoretical Numerical Analysis Kendall Atkinson 2006-04-18 This book gives an introduction to functional analysis in a way that is tailored to fit the needs of the researcher or student. The book explains the basic results of functional analysis as well as relevant topics in numerical analysis. Applications of functional analysis are given by considering numerical methods for solving partial differential equations and integral equations. The material is especially useful for researchers and students who wish to work in theoretical numerical analysis and seek a background in the "tools of the trade" covered in this book.

Advanced Numerical Methods for Differential Equations Harendra Singh 2021-06-25 Mathematical models are used to convert real-life problems using mathematical concepts and language. These models are governed by differential equations whose solutions make it easy to understand real-life problems and can be applied to engineering and science disciplines. This book presents numerical methods for solving various mathematical models. This book offers real-life applications, includes research problems on numerical treatment, and shows how to develop the numerical methods for solving problems. The book also covers theory and applications in engineering and science. Engineers, mathematicians, scientists, and researchers working on real-life mathematical problems will find this book useful.

Computational Methods in Chemical Engineering with Maple Ralph E. White 2010-02-06 This book presents Maple solutions to a wide range of problems relevant to chemical engineers and others. Many of these solutions use Maple's symbolic capability to help bridge the gap between analytical and numerical solutions. The readers are strongly encouraged to refer to the references included in the book for a better understanding of the physics involved, and for the mathematical analysis. This book was written for a senior undergraduate or a first year graduate student course in chemical engineering. Most of the examples in this book were done in Maple 10. However, the codes should run in the most recent version of Maple. We strongly encourage the readers to use the classic worksheet (*.mws) option in Maple as we believe it is more user-friendly and robust. In chapter one you will find an introduction to Maple which includes simple basics as a convenience for the reader such as plotting, solving linear and nonlinear equations, Laplace transformations, matrix operations, 'do loop,' and 'while loop.' Chapter two presents linear ordinary differential equations in section 1 to include homogeneous and nonhomogeneous ODEs, solving systems of ODEs using the matrix exponential and Laplace transform method. In section two of chapter two, nonlinear ordinary differential equations are presented and include simultaneous series reactions, solving nonlinear ODEs with Maple's 'dsolve' command, stop conditions, differential algebraic equations, and steady state solutions. Chapter three addresses boundary value problems.

Numerical Partial Differential Equations: Finite Difference Methods J.W. Thomas 2013-12-01 What makes this book stand out from the competition is that it is more computational. Once done with both volumes, readers will have the tools to attack a wider variety of problems than those worked out in the competitors' books. The author stresses the use of technology throughout the text, allowing students to utilize it as much as possible.

Sci-tech Book Profiles 1965 Includes title page, table of contents, list of contributors, preface and all indexes of each book.

Polynomial Chaos Methods for Hyperbolic Partial Differential Equations Mass Per Pettersson 2015-03-10 This monograph presents computational techniques and numerical analysis to study conservation laws under uncertainty using the stochastic Galerkin formulation. With the continual growth of computer power, these methods are becoming increasingly popular as an alternative to more classical sampling-based techniques. The text takes advantage of stochastic Galerkin projections applied to the original conservation laws to produce a large system of modified partial differential equations, the solutions to which directly provide a full statistical characterization of the effect of uncertainties. Polynomial Chaos Methods of

Hyperbolic Partial Differential Equations focuses on the analysis of stochastic Galerkin systems obtained for linear and non-linear convection-diffusion equations and for a systems of conservation laws; a detailed well-posedness and accuracy analysis is presented to enable the design of robust and stable numerical methods. The exposition is restricted to one spatial dimension and one uncertain parameter as its extension is conceptually straightforward. The numerical methods designed guarantee that the solutions to the uncertainty quantification systems will converge as the mesh size goes to zero. Examples from computational fluid dynamics are presented together with numerical methods suitable for the problem at hand: stable high-order finite-difference methods based on summation-by-parts operators for smooth problems, and robust shock-capturing methods for highly nonlinear problems. Academics and graduate students interested in computational fluid dynamics and uncertainty quantification will find this book of interest. Readers are expected to be familiar with the fundamentals of numerical analysis. Some background in stochastic methods is useful but not necessary.

Diode Lasers and Photonic Integrated Circuits Larry A. Coldren 2012-03-20 Diode Lasers and Photonic Integrated Circuits, Second Edition provides a comprehensive treatment of optical communication technology, its principles and theory, treating students as well as experienced engineers to an in-depth exploration of this field. Diode lasers are still of significant importance in the areas of optical communication, storage, and sensing. Using the same well received theoretical foundations of the first edition, the Second Edition now introduces timely updates in the technology and in focus of the book. After 15 years of development in the field, this book will offer brand new and updated material on GaN-based and quantum-dot lasers, photonic IC technology, detectors, modulators and SOAs, DVDs and storage, eye diagrams and BER concepts, and DFB lasers. Appendices will also be expanded to include quantum-dot issues and more on the relation between spontaneous emission and gain.

Finite Element and Finite Difference Methods in Electromagnetic Scattering Michael A. Morgan 1990

Analysis of Numerical Methods Eugene Isaacson 2012-04-26 This excellent text for advanced undergraduate and graduate students covers norms, numerical solutions of linear systems and matrix factoring, eigenvalues and eigenvectors, polynomial approximation, and more. Many examples and problems. 1966 edition.

Mesoscale Meteorological Modeling Roger A. Pielke 2001-12-11 The second edition of Mesoscale Meteorological Modeling is a fully revised resource for researchers and practitioners in the growing field of meteorological modeling at the mesoscale. Pielke has enhanced the new edition by quantifying model capability (uncertainty) by a detailed evaluation of the assumptions of parameterization and error propagation. Mesoscale models are applied in a wide variety of studies, including weather prediction, regional and local climate assessments, and air pollution investigations.

Mathematical Models in Agriculture J. H. M. Thornley 2007 Role of mathematical models; Dynamic deterministic models; Mathematical programming; Basic biological processes; Growth functions; Simple dynamic growth models; Simple ecological models; Environment and weather; Plant and crop processes; Crop models; Crop husbandry; Plant diseases and pests; Animal processes; Animal organs; Whole-animal models; Animal products; Animal husbandry; Animal diseases; Solutions exercises; Mathematical glossary.

Mesoscale Meteorological Modeling Roger A Pielke Sr 2013-10-08 The 3rd edition of Mesoscale Meteorological Modeling is a fully revised resource for researchers and practitioners in the growing field of meteorological modeling at the mesoscale. Pielke has enhanced the new edition by quantifying model capability (uncertainty) by a detailed evaluation of the assumptions of parameterization and error propagation. Mesoscale models are applied in a wide variety of studies, including weather prediction, regional and local climate assessments, and air pollution investigations. Broad expansion of the concepts of parameterization and parameterization methodology Addition of new modeling approaches, including modeling summaries and summaries of data sets All-new section on dynamic downscaling

Nonlinear Analysis in Chemical Engineering Bruce A. Finlayson 2003

Advances in the Applications of Nonstandard Finite Difference Schemes Ronald E Mickens 2005-10-25 This volume provides a concise introduction to the methodology of nonstandard finite difference (NSFD) schemes construction and shows how they can be applied to the numerical integration of differential equations occurring in the natural, biomedical, and engineering sciences. These methods had their genesis in the work of Mickens in the 1990's and are now beginning to be widely studied and applied by other researchers. The importance of the book derives from its clear and direct explanation of NSFD in the introductory chapter along with a broad discussion of the future directions needed to advance the topic. Contents: Nonstandard Finite Difference Methods (R E Mickens) Application of Nonstandard Finite Difference Schemes to the Simulation Studies of Robotic Systems (R F Abo-Shanab et al.) Applications of Mickens Finite Differences to Several Related Boundary Value Problems (R Buckmire) High Accuracy Nonstandard Finite-Difference Time-Domain Algorithms for Computational Electromagnetics: Applications to Optics and Photonics (J B Cole) Nonstandard Finite Difference Schemes for Solving Nonlinear Micro Heat Transport Equations in Double-Layered Metal Thin Films Exposed to Ultrashort Pulsed Lasers (W Dai) Reliable Finite Difference Schemes with Applications in Mathematical Ecology (D T Dimitrov et al.) Applications of the Nonstandard Finite Difference Method in Non-Smooth Mechanics (Y Dumont) Finite Difference Schemes on Unbounded Domains (M Ehrhardt) Asymptotically Consistent Nonstandard Finite-Difference Methods for Solving Mathematical Models Arising in Population Biology (A B Gumel et al.) Nonstandard Finite Difference Methods and Biological Models (S R-J Jang) Robust Discretizations versus Increase of the Time Step for Chaotic Systems (C Letellier & E M A M Mendes) Contributions to the Theory of Nonstandard Finite-Difference Methods and Applications to Singular Perturbation Problems (J M-S Lubuma & K C Patidar) Frequency Accurate Finite Difference Methods (A L Perkins et al.) Nonstandard Discretization Methods on Lotka-Volterra Differential Equations (L-I W Roeger) Readership: Applied mathematicians, and researchers in numerical & computational mathematics and analysis & differential equations. Usable as a secondary text to a standard undergraduate or graduate course on numerical methods for differential equations. Keywords: Numerical Integration Methods; Finite Differences; Nonstandard Finite Difference Schemes; Differential Equations; Discrete Models; Numerical and Computational Mathematics Key Features: A collection of papers from renowned experts in their respective fields Provides the most recent work on the application of NSFD schemes and some of the mathematical analysis related to these schemes

Nonlinear Analysis of Thin-Walled Structures James F. Doyle 2013-03-09 Mechanical engineering, an engineering discipline born of the needs of the Industrial Revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face the profound issues of productivity and competitiveness that require engineering solutions, among others. The Mechanical Engineering Series is a new series, featuring graduate texts and research monographs, intended to address the need for information in contemporary areas of mechanical engineering. The series is conceived as a comprehensive one that will cover a broad range of concentrations important to mechanical engineering graduate education and research. We are fortunate to have a distinguished roster of consulting editors, each an expert in one of the areas of concentration. The names of the consulting editors are listed on page vi. The areas of concentration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control, energetics, mechanics of materials, processing, thermal science, and tribology. We are pleased to present Nonlinear Analysis of Thin-Walled Structures by James F. Doyle. Austin, Texas Frederick F. Ling Preface This book is concerned with the challenging subject of the nonlinear static, dynamic, and stability analyses of thin-walled structures. It carries on from where Static and Dynamic Analysis of Structures, published by Kluwer 1991, left off; that book concentrated on frames and linear analysis, while the present book is focused on plated structures, nonlinear analysis, and a greater emphasis on stability analysis.

Numerical Methods for Stochastic Control Problems in Continuous Time Harold Kushner 2012-12-06 This book is concerned with numerical methods for stochastic control and optimal stochastic control problems. The random process models of the controlled or uncontrolled stochastic systems are either diffusions or jump diffusions. Stochastic control is a very active area of research and new problem formulations and sometimes surprising applications appear regularly. We have chosen forms of the models which cover the great bulk of the formulations of the continuous time stochastic control problems which have appeared to date. The standard formats are covered, but much emphasis is given to the newer and less well known formulations. The controlled process might be either stopped or absorbed on leaving a constraint set or upon first hitting a target set, or it might be reflected or "projected" from the boundary of a constraining set. In some of the more recent applications of the reflecting boundary problem, for example the so-called heavy traffic approximation problems, the directions of reflection are actually discontinuous. In general,

the control might be representable as a bounded function or it might be of the so-called impulsive or singular control types. Both the "drift" and the "variance" might be controlled. The cost functions might be any of the standard types: Discounted, stopped on first exit from a set, finite time, optimal stopping, average cost per unit time over the infinite time interval, and so forth.

The Finite Element Method in Electromagnetics Jian-Ming Jin 2015-02-18 A new edition of the leading textbook on the finite element method, incorporating major advancements and further applications in the field of electromagnetics The finite element method (FEM) is a powerful simulation technique used to solve boundary-value problems in a variety of engineering circumstances. It has been widely used for analysis of electromagnetic fields in antennas, radar scattering, RF and microwave engineering, high-speed/high-frequency circuits, wireless communication, electromagnetic compatibility, photonics, remote sensing, biomedical engineering, and space exploration. The Finite Element Method in Electromagnetics, Third Edition explains the method's processes and techniques in careful, meticulous prose and covers not only essential finite element method theory, but also its latest developments and applications—giving engineers a methodical way to quickly master this very powerful numerical technique for solving practical, often complicated, electromagnetic problems. Featuring over thirty percent new material, the third edition of this essential and comprehensive text now includes: A wider range of applications, including antennas, phased arrays, electric machines, high-frequency circuits, and crystal photonics The finite element analysis of wave propagation, scattering, and radiation in periodic structures The time-domain finite element method for analysis of wideband antennas and transient electromagnetic phenomena Novel domain decomposition techniques for parallel computation and efficient simulation of large-scale problems, such as phased-array antennas and photonic crystals Along with a great many examples, The Finite Element Method in Electromagnetics is an ideal book for engineering students as well as for professionals in the field.

Engineering Heat Transfer, Second Edition William S. Janna 1999-12-28 Most of the texts on heat transfer available in recent years have focused on the mathematics of the subject, typically at an advanced level. Engineering students and engineers who have not moved immediately into graduate school need a reference that provides a strong, practical foundation in heat transfer—one that emphasizes real-world problems and helps develop their problem-solving skills. Engineering Heat Transfer fills that need. Extensively revised and thoroughly updated, the Second Edition of this popular text continues to de-emphasize high level mathematics in favor of effective, accurate modeling. A generous number of real-world examples amplify the theory and show how to use derived equations to model physical problems. Exercises that parallel the examples build readers' confidence and prepare them to effectively confront the more complex situations they encounter as professionals. Concise and user-friendly, Engineering Heat Transfer covers conduction, convection, and radiation heat transfer in a manner that does not overwhelm the reader and is uniquely suited to the actual practice of engineering.

Numerical Methods for Wave Equations in Geophysical Fluid Dynamics Dale R. Durran 2013-03-14

Covering a wide range of techniques, this book describes methods for the solution of partial differential equations which govern wave propagation and are used in modeling atmospheric and oceanic flows. The presentation establishes a concrete link between theory and practice.

Exact Finite-Difference Schemes Sergey Lemeshevsky 2016-09-26 Exact Finite-Difference Schemes is a first overview of the topic also describing the state-of-the-art in this field of numerical analysis. Construction of exact difference schemes for various parabolic and elliptic partial differential equations are discussed, including vibrations and transport problems. After this, applications are discussed, such as the discretisation of ODEs and PDEs and numerical methods for stochastic differential equations. Contents: Basic notation Preliminary results Hyperbolic equations Parabolic equations Use of exact difference schemes to construct NSFD discretizations of differential equations Exact and truncated difference schemes for boundary-value problem Exact difference schemes for stochastic differential equations Numerical blow-up time Bibliography

Nonstandard Finite Difference Schemes: Methodology And Applications Ronald E Mickens 2020-11-11 This second edition of Nonstandard Finite Difference Models of Differential Equations provides an update on the progress made in both the theory and application of the NSFD methodology during the past two and a half decades. In addition to discussing details related to the determination of the denominator functions and the nonlocal discrete representations of functions of dependent variables, we include many examples illustrating just how this should be done. Of real value to the reader is the inclusion of a chapter listing many exact difference schemes, and a chapter giving NSFD schemes from the research literature. The book emphasizes the critical roles played by the 'principle of dynamic consistency' and the use of sub-equations for the construction of valid NSFD discretizations of differential equations.

Analysis of a Finite Element Method Granville Sewell 2012-12-06 This text can be used for two quite different purposes. It can be used as a reference book for the PDEIPROTRAN user who wishes to know more about the methods employed by PDE/PROTRAN Edition 1 (or its predecessor, TWODEPEP) in solving two-dimensional partial differential equations. However, because PDE/PROTRAN solves such a wide class of problems, an outline of the algorithms contained in PDEIPROTRAN is also quite suitable as a text for an introductory graduate level finite element course. Algorithms which solve elliptic, parabolic, hyperbolic, and eigenvalue partial differential equation problems are presented, as are techniques appropriate for treatment of singularities, curved boundaries, nonsymmetric and nonlinear problems, and systems of PDEs. Direct and iterative linear equation solvers are studied. Although the text emphasizes those algorithms which are actually implemented in PDEIPROTRAN, and does not discuss in detail one- and three-dimensional problems, or collocation and least squares finite element methods, for example, many of the most commonly used techniques are studied in detail. Algorithms applicable to general problems are naturally emphasized, and not special purpose algorithms which may be more efficient for specialized problems, such as Laplace's equation. It can be argued, however, that the student will better understand the finite element method after seeing the details of one successful implementation than after seeing a broad overview of the many types of elements, linear equation solvers, and other options in existence.

Keller-Box Method and Its Application Kuppapalalle Vajravelu 2014-06-18 Most of the problems arising in science and engineering are nonlinear. They are inherently difficult to solve. Traditional analytical approximations are valid only for weakly nonlinear problems, and often break down for problems with strong nonlinearity. This book presents the current theoretical developments and applications of Keller-Box method to nonlinear problems. The first half of the book addresses basic concepts to understand the theoretical framework for the method. In the second half of the book, the authors give a number of examples of coupled nonlinear problems that have been solved by means of the Keller-Box method. The particular area of focus is on fluid flow problems governed by nonlinear equations.

Handbook of Computational Economics Karl Schmedders 2013-12-31 Handbook of Computational Economics summarizes recent advances in economic thought, revealing some of the potential offered by modern computational methods. With computational power increasing in hardware and algorithms, many economists are closing the gap between economic practice and the frontiers of computational mathematics. In their efforts to accelerate the incorporation of computational power into mainstream research, contributors to this volume update the improvements in algorithms that have sharpened econometric tools, solution methods for dynamic optimization and equilibrium models, and applications to public finance, macroeconomics, and auctions. They also cover the switch to massive parallelism in the creation of more powerful computers, with advances in the development of high-power and high-throughput computing. Much more can be done to expand the value of computational modeling in economics. In conjunction with volume one (1996) and volume two (2006), this volume offers a remarkable picture of the recent development of economics as a science as well as an exciting preview of its future potential. Samples different styles and approaches, reflecting the breadth of computational economics as practiced today Focuses on problems with few well-developed solutions in the literature of other disciplines Emphasizes the potential for increasing the value of computational modeling in economics

Numerical Methods and Modeling for Chemical Engineers Mark E. Davis 2013 "Geared toward advanced undergraduates or graduate students of chemical engineering studying applied mathematics, this text introduces the quantitative treatment of differential equations arising from modeling physical phenomena in chemical engineering. Coverage includes topics such as ODE-IVPs, placing emphasis on numerical methods and modeling implemented in commercial mathematical software available in 1985"--

Fundamentals of Heat and Mass Transfer Theodore L. Bergman 2011-04-12 Completely updated, the seventh edition provides engineers with an in-depth look at the key concepts in the field. It incorporates new discussions on emerging areas of heat transfer, discussing technologies that are related to nanotechnology, biomedical engineering and alternative energy. The example problems are also updated to better show how to apply the material. And as engineers follow the rigorous and systematic problem-solving methodology, they'll gain an appreciation for the richness and beauty of the discipline.