Differential Quadrature And Its Application In Engineering Engineering Applications

In the past few years, the differential quadrature method has been applied extensively in engineering. This book, aimed primarily at practising engineers, scientists and graduate students, gives a systematic description of the mathematical fundamentals of differential quadrature and its detailed implementation in solving Helmholtz problems and problems of flow, structure and vibration. Differential quadrature provides a global approach to numerical discretization, which approximates the derivatives by a linear weighted sum of all the functional values in the whole domain. Following the analysis of function approximation and the analysis of a linear vector space, it is shown in the book that the weighting coefficients of the polynomial-based, Fourier expansion-based, and exponential-based differential quadrature methods can be computed explicitly. It is also demonstrated that the polynomial-based differential quadrature method is equivalent to the highest-order finite difference scheme. Furthermore, the relationship between differential quadrature and conventional spectral collocation is analysed. The book contains material on: - Linear Vector Space Analysis and the Approximation of a Function; - Polynomial-, Fourier Expansion- and Exponential-based Differential Quadrature; - Differential Quadrature Weighting Coefficient Matrices; - Solution of Differential Quadrature-resultant Equations; - The Solution of Incompressible Navier-Stokes and Helmholtz Equations; - Structural and Vibrational Analysis Applications; - Generalized Integral Quadrature and its Application in the Solution of Boundary Layer Equations. Three FORTRAN programs for simulation of driven cavity flow, vibration analysis of plate and Helmholtz eigenvalue problems respectively, are appended. These sample programs should give the reader a better understanding of differential quadrature and can easily be modified to solve the readers own engineering problems.

In the past few years, the differential quadrature (DQ) method has been extensively applied in engineering. This book gives a systematic description of the mathematical fundamentals for the DQ method and its detailed implementation in solving the flow, structural, as well as Helmholtz problems. The DQ method is a global approach for numerical discretization, which approximates the derivatives by a linear wighted sum of all the functional values in the whole domain. Following the analysis of function approximation and the analysis of a linear vector space, it is shown in the book that the weighting coefficients of the polynomial-based, Fourier expansion-based, and the exponential-based DQ methods can be computed explicitly. It is also demonstrated that the polynomial-based DQ method is equivalent to the highest order finite difference scheme. Furthermore, the relationship between the DQ method and the conventional spectral collocation method is analyzed. Three FORTRAN programs are attached respectively for simulation of driven cavity flow, vibration analysis of plate, and Helmholtz eigenvalue problem. It is believed that through the three sample programs, the readers can understand the DQ method better and can easily modify the programs to solve their own engineering problems.

The purpose of this book is to present some new methods in the treatment of partial differential equations. Some of these methods lead to effective numerical algorithms when combined with the digital computer. Also presented is a useful chapter on Green's functions which generalizes, after an introduction, to new methods of obtaining Green's functions for partial differential operators. Finally some very new material is presented on solving partial differential equations by Adomian's decomposition methodology. This method can yield realistic computable solutions for linear or non linear cases even for strong nonlinearities, and also for deterministic or stochastic cases - again even if strong stochasticity is involved. Some interesting examples are discussed here and are to be followed by a book dealing with frontier applications in physics and engineering. In Chapter I, it is shown that a use of positive operators can lead to monotone convergence for various classes of nonlinear partial differential equations. In Chapter II, the utility of conservation technique is shown. These techniques are suggested by physical principles. In Chapter III, it is shown that dyn~mic programming applied to variational problems leads to interesting classes of nonlinear partial differential equations. In Chapter IV, this is investigated in greater detail. In Chapter V, we show. that the use of a transformation suggested by dynamic programming leads to a new method of successive approximations.

Gaussian quadrature is a powerful technique for numerical integration that falls under the broad category of spectral methods. The purpose of this work is to provide an introduction to the theory and practice of Gaussian quadrature. We study the approximation theory of trigonometric and orthogonal polynomials and related functions and examine the analytical framework of Gaussian quadrature. We discuss Gaussian quadrature for bandlimited functions, a topic inspired by some recent developments in the analysis of prolate spheroidal wave functions. Algorithms for the computation of the quadrature nodes and weights are described. Several applications of Gaussian quadrature are given, ranging from the evaluation of special functions to pseudospectral methods for solving differential equations. Software realization of select algorithms is provided. Table of Contents: Introduction / Approximating with Polynomials and Related Functions / Gaussian Quadrature / Applications / Links to Mathematical Software

The aim of this book is to provide a systematic and practical account of methods of integration of ordinary and partial differential equations based on invariance under continuous (Lie) groups of trans formations. The goal of these methods is the expression of a solution in terms of quadrature in the case of ordinary differential equations of first order and a reduction in order for higher order equations. For partial differential equations at least a reduction in the number of independent variables is sought and in favorable cases a reduction to ordinary differential equations with special solutions or quadrature. In the last century, approximately one hundred years ago, Sophus Lie tried to construct a general integration theory, in the above sense, for ordinary differential equations. Following Abel's approach for algebraic equations he studied the invariance of ordinary differential equations under transformations. In particular, Lie introduced the study of continuous groups of transformations of ordinary differential equations, based on the infinitesimal properties of the group. In a sense the theory was completely successful. It was shown how for a first-order differential equation the knowledge of a group leads immediately to quadrature, and for a higher order equation (or system) to a reduction in order. In another sense this theory is somewhat disappointing in that for a first-order differ ential equation essentially no systematic way can be given for finding the groups or showing that they do not exist for a first-order differential equation.

This book offers the latest research advances in the field of mathematics applications in engineering sciences and provides a reference with a theoretical and sound background, along with case studies. In recent years, mathematics has had an amazing growth in engineering sciences. It forms the common foundation of all engineering disciplines. This new book provides a comprehensive range of mathematics applied to various fields of engineering for different tasks in fields such as civil engineering, structural engineering, computer science, electrical engineering, among others. It offers articles that develop the applications of mathematics in engineering sciences, conveys the innovative research ideas, offers real-world utility of mathematics, and plays a significant role in the life of academics, practitioners, researchers, and industry leaders. Focuses on the latest research in the field of engineering applications Includes recent findings from various institutions Identifies the gaps in the knowledge of the field and provides the latest approaches Presents international studies and findings in modelling and simulation Offers various mathematical tools, techniques, strategies, and methods across different engineering fields

This volume covers a diverse collection of topics dealing with some of the fundamental concepts and applications embodied in the study of nonlinear dynamics. Each of the 15 chapters contained in this compendium generally fit into one of five topical areas: physics applications, nonlinear oscillators, electrical and mechanical systems, biological and behavioral applications or random processes. The authors of these chapters have contributed a stimulating cross section of new results, which provide a fertile spectrum of ideas that will inspire both seasoned researches and students.

The main aim of this book is to show the features of DiQuMASPAB so ware through the description of its graphical interface, by giving special emphasis to all those aspects implemented in the code. DiQuMASPAB, acronym of “Differential Quadrature for Mechanics of Anisotropic Shells, Plates, Arches and Beams”, is a computational code, which can be used for the numerical analysis of doubly curved shells made of innovative materials, using the Generalized Differential Quadrature (GDQ) and the Generalized Integral Quadrature (GIQ) methods. The software can investigate the mechanical behavior of these structures through different approaches and structural theories. In particular, this code allows considering a kinematic expansion characterized by different degrees of freedom for the Equivalent Single Layer (ESL) theories and for each layer when the Layer-Wise (LW) approach is taken into account. As far as the materials are concerned, it is possible to consider different lamination schemes, as well as various distributions of the volume fraction of the constituents for those layers that vary their mechanical properties along the thickness. In addition, the software analyzes structures with variable thickness and characterized by variable mechanical properties that can change point by point. A finite element formulation is also available to investigate the mechanical behavior of plane structures characterized by irregular domains and mechanical discontinuities.

This manuscript comes from the experience gained over ten years of study and research on shell structures and on the Generalized Differential Quadrature method. The title, Mechanics of Laminated Composite Doubly-Curved Shell Structures, illustrates the theme followed in the present volume. The present study aims to analyze the static and dynamic behavior of moderately thick shells made of composite materials through the application of the Differential Quadrature (DQ) technique. A particular attention is paid, other than fibrous and laminated composites, also to “Functionally Graded Materials” (FGMs). They are non-homogeneous materials, characterized by a continuous variation of the mechanical properties through a particular direction. The GDQ numerical solution is compared, not only with literature results, but also with the ones supplied and obtained through the use of different structural codes based on the Finite Element Method (FEM). Furthermore, an advanced version of GDQ method is also presented. This methodology is termed Strong Formulation Finite Element Method (SFEM) because it employs the strong form of the differential system of equations at the master element level and the mapping technique, proper of FEM. The connectivity between two elements is enforced through compatibility conditions.

Here is an elementary development of the Sinc-Galerkin method with the focal point being ordinary and partial differential equations. This is the first book to explain this powerful computational method for treating differential equations. These methods are an alternative to finite difference and finite element schemes, and are especially adaptable to problems with singular solutions. The text is written to facilitate easy implementation of the theory into operating numerical code. The authors' use of differential equations as a backdrop for the presentation of the material allows them to present a number of the applications of the sinc method. Many of these applications are useful in numerical processes of interest quite independent of differential equations. Specifically, numerical interpolation and quadrature, while fundamental to the Galerkin development, are useful in their own right.

Analysis of nonlinear models and problems is crucial in the application of mathematics to real-world problems. This book approaches this important topic by focusing on collocation methods for solving nonlinear evolution equations and applying them to a variety of mathematical problems. These include wave motion models, hydrodynamic models of vehicular traffic flow, convection-diffusion models, reaction-diffusion models, and population dynamics models. The book may be used as a textbook for graduate courses on collocation methods, nonlinear modeling, and nonlinear differential equations. Examples and exercises are included in every chapter.

Meshless, or meshfree methods, which overcome many of the limitations of the finite element method, have achieved significant progress in numerical computations of a wide range of engineering problems. A comprehensive introduction to meshless methods, Meshless Methods and Their Numerical Properties gives complete mathematical formulations for the most important and classical methods, as well as several methods recently developed by the authors. This book also offers a rigorous mathematical treatment of their numerical properties—including consistency, convergence, stability, and adaptivity—to help you choose the method that is best suited for your needs. Get Guidance for Developing and Testing Meshless Methods Developing a broad framework to study the numerical computational characteristics of meshless methods, the book presents consistency, convergence, stability, and adaptive analyses to offer guidance for developing and testing a particular meshless method. The authors demonstrate the numerical properties by solving several differential equations, which offer a clearer understanding of the concepts. They also explain the difference between the finite element and meshless methods. Explore Engineering Applications of Meshless Methods The book examines how meshless methods can be used to solve complex engineering problems with lower computational cost, higher accuracy, easier construction of higher-order shape functions, and easier handling of large deformation and nonlinear problems. The numerical examples include engineering problems such as the CAD design of MEMS devices, nonlinear fluid-structure analysis of near-bed submarine pipelines, and two-dimensional multiphysics simulation of pH-sensitive hydrogels. Appendices supply useful template functions, flowcharts, and data structures to assist you in implementing meshless methods. Choose the Best Method for a Particular Problem Providing insight into the special features and intricacies of meshless methods, this is a valuable reference for anyone developing new high-performance numerical methods or working on the modelling and simulation of practical engineering problems. It guides you in comparing and verifying meshless methods so that you can more confidently select the best method to solve a particular problem.

During the past 20 years, there has been enormous productivity in theoretical as well as computational integration. Some attempts have been made to find an optimal or best numerical method and related computer code to put to rest the problem of numerical integration, but the research is continuously ongoing, as this problem is still very much open-ended. The importance of numerical integration in so many areas of science and technology has made a practical, up-to-date reference on this subject long overdue. The Handbook of Computational Methods for Integration discusses quadrature rules for finite and infinite range integrals and their applications in differential and integral equations, Fourier integrals and transforms, Hartley transforms, fast Fourier and Hartley transforms, Laplace transforms and wavelets. The practical, applied perspective of this book makes it unique among the many theoretical books on numerical integration and quadrature. It will be a welcomed addition to the libraries of applied mathematicians, scientists, and engineers in virtually every discipline.

This book covers recent advances in the method used in testing, especially in the case of structural integrity that includes fatigue and fracture tests, vibrations test and surface engineering tests that are extremely crucial and widely used by engineers and industries. The book will provide you with information on how to apply the advanced formulation, advanced theory and advanced method of testing that are relevant to all engineering fields: mechanical, electrical, civil, materials and surface engineering. The topics are explained comprehensively, including the reliable test that one should perform in order to effectively investigate the strength and validation of the developed theory or model. I hope that the material is not too theoretical and that the reader finds the case study, formulation, testing method and the analysis helpful for tackling their own engineering and science based studies.

Differential Quadrature and Differential Quadrature Based Element Methods: Theory and Applications is a comprehensive guide to these methods and their various applications in recent years. Due to the attractive features of rapid convergence, high accuracy, and computational efficiency, the differential quadrature method and its based element methods are increasingly being used to study problems in the area of structural mechanics, such as static, buckling and vibration problems of composite structures and functional material structures. This book covers new developments and their applications in detail, with accompanying FORTRAN and MATLAB programs to help you overcome difficult programming challenges. It summarises the variety of different quadrature formulations that can be found by varying the degree of polynomials, the treatment of boundary conditions and employing regular or irregular grid points, to help you choose the correct method for solving practical problems. Offers a clear explanation of both the theory and many applications of DQM to structural analyses Discusses and illustrates reliable ways to apply multiple boundary conditions and develop reliable grid distributions Supported by FORTRAN and MATLAB programs, including subroutines to compute grid distributions and weighting coefficients

The title, “Laminated Composite Doubly-Curved Shell Structures. Differential and Integral Quadrature. Strong Form Finite Elements” illustrates the theme treated and the prospective followed during the composition of the present work. The aim of this manuscript is to analyze the static and dynamic behavior of thick and moderately thick composite shells through the application of the Differential Quadrature (DQ) method. The book is divided into two volumes wherein the principal higher order structural theories are illustrated in detail and the mechanical behavior of doubly-curved structures are presented by several static and dynamic numerical applications. In particular, the first volume is mainly theoretical, whereas the second one is mainly related to the numerical DQ technique and its applications in the structural field. The numerical results reported in the present volume are compared to the one available in the literature, but also to the ones obtained through several codes based on the Finite Element Method (FEM). Furthermore, an advanced version of the DQ method, termed Strong Formulation Finite Element Method (SFEM), is presented. The SFEM solves the differential equations inside each element in the strong form and implements the mapping technique typical of the FEM.

Examines numerical and semi-analytical methods for differential equations that can be used for solving practical ODEs and PDEs This student-friendly book deals with various approaches for solving differential equations numerically or semi-analytically depending on the type of equations and offers simple example problems to help readers along. Featuring both traditional and recent methods, Advanced Numerical and Semi Analytical Methods for Differential Equations begins with a review of basic numerical methods. It then looks at Laplace, Fourier, and weighted residual methods for solving differential equations. A new challenging method of Boundary Characteristics Orthogonal Polynomials (BCOPs) is introduced next. The book then discusses Finite Difference Method (FDM), Finite Element Method (FEM), Finite Volume Method (FVM), and Boundary Element Method (BEM). Following that, analytical/semi analytic methods like Akbari Ganji's Method (AGM) and Exp-function are used to solve nonlinear differential equations. Nonlinear differential equations using semi-analytical methods are also addressed, namely Adomian Decomposition Method (ADM), Homotopy Perturbation Method (HPM), Variational Iteration Method (VIM), and Homotopy Analysis Method (HAM). Other topics covered include: emerging areas of research related to the solution of differential equations based on differential quadrature and wavelet approach; combined and hybrid methods for solving differential equations; as well as an overview of fractal differential equations. Further, uncertainty in term of intervals and fuzzy numbers have also been included, along with the interval finite element method. This book: Discusses various methods for solving linear and nonlinear ODEs and PDEs Covers basic numerical techniques for solving differential equations along with various discretization methods Investigates nonlinear differential equations using semi-analytical methods Examines differential equations in an uncertain environment Includes a new scenario in which uncertainty (in term of intervals and fuzzy numbers) has been included in differential equations Contains solved example problems, as well as some unsolved problems for self-validation of the topics covered Advanced Numerical and Semi Analytical Methods for Differential Equations is an excellent text for graduate as well as post graduate students and researchers studying various methods for solving differential equations, numerically and semi-analytically.

Theory, methods and software for elliptic (steady-state) and parabolic (diffusion) partial differential equations, plus linear algebra and error estimators.

Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics presents a new approach to numerical analysis for modern computer scientists. Using examples from a broad base of computational tasks, including data processing, computational photography, and animation, the textbook introduces numerical modeling and algorithmic desig

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In recent years, mathematics has experienced amazing growth in the engineering sciences. Mathematics forms the common foundation of all engineering disciplines. This book provides a comprehensive range of mathematics applied in various fields of engineering for different tasks such as civil engineering, structural engineering, computer science, and electrical engineering, among others. It offers chapters that develop the applications of mathematics in engineering sciences, conveys the innovative research ideas, offers real-world utility of mathematics, and has a significance in the life of academics, practitioners, researchers, and industry leaders. Features Focuses on the latest research in the field of engineering applications Includes recent findings from various institutions Identifies the gaps in the knowledge in the field and provides the latest approaches Presents international studies and findings in modeling and simulation Offers various mathematical tools, techniques, strategies, and methods across different engineering fields

By using computer simulations in research and development, computational science and engineering (CSE) allows empirical inquiry where traditional experimentation and methods of inquiry are difficult, inefficient, or prohibitively expensive. The Handbook of Research on Computational Science and Engineering: Theory and Practice is a reference for interested researchers and decision-makers who want a timely introduction to the possibilities in CSE to advance their ongoing research and applications or to discover new resources and cutting edge developments. Rather than reporting results obtained using CSE models, this comprehensive survey captures the architecture of the cross-disciplinary field, explores the long term implications of technology choices, alerts readers to the hurdles facing CSE, and identifies trends in future development.

This book is a tutorial written by researchers and developers behind the FEniCS Project and explores an advanced, expressive approach to the development of mathematical software. The presentation spans mathematical background, software design and the use of FEniCS in applications. Theoretical aspects are complemented with computer code which is available as free/open source software. The book begins with a special introductory tutorial for beginners. Following are chapters in Part I addressing fundamental aspects of the approach to automating the creation of finite element solvers. Chapters in Part II address the design and implementation of the FEnicS software. Chapters in Part III present the application of FEniCS to a wide range of applications, including fluid flow, solid mechanics, electromagnetics and geophysics.

In the recent decades, there has been a growing interest in micro- and nanotechnology. The advances in nanotechnology give rise to new applications and new types of materials with unique electromagnetic and mechanical properties. This book is devoted to the modern methods in electrodynamics and acoustics, which have been developed to describe wave propagation in these modern materials and nanodevices. The book consists of original works of leading scientists in the field of wave propagation who produced new theoretical and experimental methods in the research field and obtained new and important results. The first part of the book consists of chapters with general mathematical methods and approaches to the problem of wave propagation. A special attention is attracted to the advanced numerical methods fruitfully applied in the field of wave propagation. The second part of the book is devoted to the problems of wave propagation in newly developed metamaterials, micro- and nanostructures and porous media. In this part the interested reader will find important and fundamental results on electromagnetic wave propagation in media with negative refraction index and electromagnetic imaging in devices based on the materials. The third part of the book is devoted to the problems of wave propagation in elastic and piezoelectric media. In the fourth part, the works on the problems of wave propagation in plasma are collected. The fifth, sixth and seventh parts are devoted to the problems of wave propagation in media with chemical reactions, in nonlinear and disperse media, respectively. And finally, in the eighth part of the book some experimental methods in wave propagations are considered. It is necessary to emphasize that this book is not a textbook. It is important that the results combined in it are taken "from the desks of researchers". Therefore, I am sure that in this book the interested and actively working readers (scientists, engineers and students) will find many interesting results and new ideas.

Written by the world's leading researchers on various topics of linear, nonlinear, and stochastic mechanical vibrations, this work gives an authoritative overview of the classic yet still very modern subject of mechanical vibrations. It examines the most important contributions to the field made in the past decade, offering a critical and comprehensive portrait of the subject from various complementary perspectives.

This book consists of important contributions by world-renowned experts on adaptive high-order methods in computational fluid dynamics (CFD). It covers several widely used, and still intensively researched methods, including the discontinuous Galerkin, residual distribution, finite volume, differential quadrature, spectral volume, spectral difference, PNPM, and correction procedure via reconstruction methods. The main focus is applications in aerospace engineering, but the book should also be useful in many other engineering disciplines including mechanical, chemical and electrical engineering. Since many of these methods are still evolving, the book will be an excellent reference for researchers and graduate students to gain an understanding of the state of the art and remaining challenges in high-order CFD methods.

Traditionally, design and control decisions are made in sequential stages over the life cycle of a chemical plant. In the design phase, the optimal operating conditions and the corresponding material and energy balance data are established mainly on the basis of economic considerations. In the subsequent step, the control systems are configured to maintain the key process conditions at the fixed nominal values. Because it is often desirable to address the operability issues at the earliest possible stage before stipulation of control schemes, the systematic incorporation of flexibility analysis in process synthesis and design has received considerable attention in recent years. This book focuses to a large extent on computation and implementation methods of deterministic performance measures, i.e., the steady-state, volumetric, dynamic and temporal flexibility indices, in various applications. The formal definitions of several available performance indices, their mathematical formulations, and the corresponding algorithms and codes are provided in sufficient detail to facilitate implementation. To show the utility of flexibility analyses, the book presents several practical case studies including membrane modules and heat-exchanger networks, solar-driven membrane distillation desalination systems, and hybrid power generation systems. It also includes MATLAB and GAMS codes.

Modern Tools to Perform Numerical Differentiation The original direct differential quadrature (DQ) method has been known to fail for problems with strong nonlinearity and material discontinuity as well as for problems involving singularity, irregularity, and multiple scales. But now researchers in applied mathematics, computational mechanics, and engineering have developed a range of innovative DQ-based methods to overcome these shortcomings. Advanced Differential Quadrature Methods explores new DQ methods and uses these methods to solve problems beyond the capabilities of the direct DQ method. After a basic introduction to the direct DQ method, the book presents a number of DQ methods, including complex DQ, triangular DQ, multi-scale DQ, variable order DQ, multi-domain DQ, and localized DQ. It also provides a mathematical compendium that summarizes Gauss elimination, the Runge–Kutta method, complex analysis, and more. The final chapter contains three codes written in the FORTRAN language, enabling readers to quickly acquire hands-on experience with DQ methods. Focusing on leading-edge DQ methods, this book helps readers understand the majority of journal papers on the subject. In addition to gaining insight into the dynamic changes that have recently occurred in the field, readers will quickly master the use of DQ methods to solve complex problems.

Fractional calculus was first developed by pure mathematicians in the middle of the 19th century. Some 100 years later, engineers and physicists have found applications for these concepts in their areas. However there has traditionally been little interaction between these two communities. In particular, typical mathematical works provide extensive findings on aspects with comparatively little significance in applications, and the engineering literature often lacks mathematical detail and precision. This book bridges the gap between the two communities. It concentrates on the class of fractional derivatives most important in applications, the Caputo operators, and provides a self-contained, thorough and mathematically rigorous study of their properties and of the corresponding differential equations. The text is a useful tool for mathematicians and researchers from the applied sciences alike. It can also be used as a basis for teaching graduate courses on fractional differential equations.

Given the risk of earthquakes in many countries, knowing how structural dynamics can be applied to earthquake engineering of structures, both in theory and practice, is a vital aspect of improving the safety of buildings and structures. It can also reduce the number of deaths and injuries and the amount of property damage. The book begins by discussing free vibration of single-degree-of-freedom (SDOF) systems, both damped and undamped, and forced vibration (harmonic force) of SDOF systems. Response to periodic dynamic loadings and impulse loads are also discussed, as are two degrees of freedom linear system response methods and free vibration of multiple degrees of freedom. Further chapters cover time history response by natural mode superposition, numerical solution methods for natural frequencies and mode shapes and differential quadrature, transformation and Finite Element methods for vibration problems. Other topics such as earthquake ground motion, response spectra and earthquake analysis of linear systems are discussed. Structural dynamics of earthquake engineering: theory and application using Mathematica and Matlab provides civil and structural engineers and students with an understanding of the dynamic response of structures to earthquakes and the common analysis techniques employed to evaluate these responses. Worked examples in Mathematica and Matlab are given. Explains the dynamic response of structures to earthquakes including periodic dynamic loadings and impulse loads Examines common analysis techniques such as natural mode superposition, the finite element method and numerical solutions Investigates this important topic in terms of both theory and practise with the inclusion of practical exercise and diagrams

Exponential Fitting is a procedure for an efficient numerical approach of functions consisting of weighted sums of exponential, trigonometric or hyperbolic functions with slowly varying weight functions. This book is the first one devoted to this subject. Operations on the functions described above like numerical differentiation, quadrature, interpolation or solving ordinary differential equations whose solution is of this type, are of real interest nowadays in many phenomena as oscillations, vibrations, rotations, or wave propagation. The authors studied the field for many years and contributed to it. Since the total number of papers accumulated so far in this field exceeds 200 and the fact that these papers are spread over journals with various profiles (such as applied mathematics, computer science, computational physics and chemistry) it was time to compact and to systematically present this vast material. In this book, a series of aspects is covered, ranging from the theory of the procedure up to direct applications and sometimes including ready to use programs. The book can also be used as a textbook for graduate students.

This book is intended for medical students and advanced undergraduates such as physicists and mathematicians with inter-disciplinary interests, biophysicists, medical physicists, applied mathematicians and others who wish to understand medicine in mathematical terms as well as current mathematical applications in physiology and medicine. The mathematical presentation is clear and self-contained.This book, representing 15 years of work at RAND Corporation and USC on chemotherapy, pharmacokinetics and nuclear medicine, attempts to direct medical scientists towards mathematical aspects of problems in medicine. The book begins with an introduction to compartmental models and matrix theory, highlighting the advantages of the approach. Discussions on how questions in observations and testing lead to multi-point boundary value problems are presented. The potentials of the digital computer in the bio-medical field are examined. A new approach — dynamic programming — to overcome clinical constraints is covered in detail. The reader should obtain a broad impression of where future research opportunities in the biochemical field lie.

Brings mathematics to bear on your real-world, scientific problems Mathematical Methods in Interdisciplinary Sciences provides a practical and usable framework for bringing a mathematical approach to modelling real-life scientific and technological problems. The collection of chapters Dr. Snehashish Chakraverty has provided describe in detail how to bring mathematics, statistics, and computational methods to the fore to solve even the most stubborn problems involving the intersection of multiple fields of study. Graduate students, postgraduate students, researchers, and professors will all benefit significantly from the author's clear approach to applied mathematics. The book covers a wide range of interdisciplinary topics in which mathematics can be brought to bear on challenging problems requiring creative solutions. Subjects include: Structural static and vibration problems Heat conduction and diffusion problems Fluid dynamics problems The book also covers topics as diverse as soft computing and machine intelligence. It concludes with examinations of various fields of application, like infectious diseases, autonomous car and monotone inclusion problems.

The differential quadrature hierarchical finite element method (DQHFEM) was proposed by Bo Liu. This method incorporated the advantages and the latest research achievements of the hierarchical finite element method (HFEM), the differential quadrature method (DQM) and the isogeometric analysis (IGA). The DQHFEM also overcame many limitations or difficulties of the three methods.This unique compendium systemically introduces the construction of various DQHFEM elements of commonly used geometric shapes like triangle, tetrahedrons, pyramids, etc. Abundant examples are also included such as statics and dynamics, isotropic materials and composites, linear and nonlinear problems, plates as well as shells and solid structures.This useful reference text focuses largely on numerical algorithms, but also introduces some latest advances on high order mesh generation, which often has been regarded as the major bottle neck for the wide application of high order FEM.