Chapter 5 Transient Heat Conduction Analytical Methods

Filling the gap between basic undergraduate courses and advanced graduate courses, this text explains how to analyze and solve conduction, convection, and radiation heat transfer problems analytically. It describes many well-known analytical methods and their solutions, such as Bessel functions, separation of variables, similarity method, integral method, and matrix inversion method. Developed from the author's 30 years of teaching, the text also presents step-by-step mathematical formula derivations, analytical solution procedures, and numerous demonstration examples of heat transfer applications.

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new edition updated the material by expanding coverage of certain topics, adding new examples and problems, removing outdated material, and adding a computer disk, which will be included with each book.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.

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.

Volume V of the High Speed Aerodynamics and Jet Propulsion Series. Topics include transition from laminar to turbulent flow; turbulent flow; statistical theories of turbulence; conduction of heat; convective heat transfer and friction in flow of liquids; convective heat transfer in gases; cooling by protective fluid films; physical basis of thermal radiation; and engineering calculations of radiant heat exchange. Originally published in 1959. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

Advanced Heat Transfer
Inverse Heat Transfer
Computational Heat Transfer
Heat Transfer In Food Cooling Applications
Polymer Processing

Heat Transfer Principles and Applications is a welcome change from more encyclopedic volumes exploring heat transfer. This shorter text fully explains the fundamentals of heat transfer, including heat conduction, convection, radiation and heat exchangers. The fundamentals are then applied to a variety of engineering examples, including topics of special and current interest like solar collectors, cooling of electronic equipment, and energy conservation in buildings. The text covers both analytical and numerical solutions to heat transfer problems and makes considerable use of Excel and MATLAB(R) in the solutions. Each chapter has several example problems and a large, but not overwhelming, number of end-of-chapter problems.

Completely updated, the sixth 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.

A core task of engineers is to analyse energy related problems. The analytical treatment is usually based on principles of thermodynamics, fluid mechanics and heat transfer, but is increasingly being handled computationally. This unique resource presents a practical textbook, written for both undergraduates and professionals, with a series of over 60 computer workbooks on an accompanying CD. The book emphasizes how complex problems can be deconstructed into a series of simple steps. All thermophysical property computations are illustrated using diagrams within text and on the companion CD.

Finding the unknowns in directly inaccessible areas is one of the challenging problems in engineering applications. The fluid flow or thermal conditions of the flow inside the pipe are examples of such unknowns. Developing analytical models that provide explicit mathematical formulas is a mathematically efficient and desirable way of dealing with these challenges. This dissertation focuses on developing an analytical solution that can find the temperature distribution in radial and axial directions in the pipe wall. Partial heating along with Green's functions is used to develop this solution. Working with Greens functions sparked the idea of using them as building blocks for a novel numerical method for solving the heat conduction equation. In the second chapter, the transient temperature response inside the pipe to the partial heating on it is found using GFs and the solution is verified using a few intrinsic verification principles. This analytical solution, then, is used in developing a non-invasive method for measuring the flow rate in pipes by measuring the temperature at a single point. Optimal experiment design methods are used to find the optimal location and time duration for performing the measurement. Chapter 3 is about developing a novel numerical solution to the linear heat conduction equation. This method uses superposition of exact solutions (SES), obtained using GFs, to evaluate the temperature and heat flux at any point of the 1-D domain. The SES method is not sensitive to the size of the grids and is much more accurate than the conventional Crank Nicolson (CN) method. This method is extended to the cases in which the thermal properties vary with temperature, later, in Chapter 4. The results confirm the grid independence of the SES and show high accuracy in its prediction when the time step is not large. One of the applications of the analytical solution obtained herein is using them in solving inverse problems. Inverse heat conduction problems (IHCPs) are used to estimate unknown heat flux functions through measuring temperatures far from active surfaces. The second part of this dissertation (Chapters 5 and 6) focuses on generalizing and optimizing two IHCP solution methods.

Pergamon Unified Engineering Series
Turbulent Flows and Heat Transfer
Heat and Mass Transfer
Elementary Heat Transfer Analysis
Fundamentals of Heat and Mass Transfer

This book introduces the fundamental concepts of inverse heat transfer solutions and their application for solving problems in convective, conductive, radiative, and multi-physics problems. Inverse Heat Transfer: Fundamentals and Applications, Second Edition includes techniques within the Bayesian framework of statistics for solution of inverse problems. By modernizing the classic work of the late Professor M. Necat Ozisik and adding new examples and problems, this new edition provides a powerful tool for instructors, researchers, and graduate students studying thermal-fluid systems and heat transfer. FEATURES Introduces the fundamental concepts of inverse heat transfer Presents in systematic fashion the basic steps of powerful inverse solution techniques Develops inverse techniques of parameter estimation, function estimation, and state estimation Applies these inverse techniques to the solution of practical inverse heat transfer problems Shows inverse techniques for conduction, convection, radiation, and multi-physics phenomena Helcio R. B. Orlande is a Professor of Mechanical Engineering at the Federal University of Rio de Janeiro (UFRJ), where he was the Department Head from 2006 to 2007.

Fundamental concepts coupled with practical, step-by-step guidance With its emphasis on core principles, this text equips readers with the skills and knowledge to design the many processes needed to safely and successfully manufacture thermoplastic parts. The first half of the text sets forth the general theory and concepts underlying polymer processing, such as the viscoelastic response of polymeric fluids and diffusion and mass transfer. Next, the text explores specific practical aspects of polymer processing, including mixing, extrusion dies, and post-die processing. By addressing a broad range of design issues and methods, the authors demonstrate how to solve most common processing problems. This Second Edition of the highly acclaimed Polymer Processing has been thoroughly updated to reflect current polymer processing issues and practices. New areas of coverage include: Micro-injection molding to produce objects weighing a fraction of a gram, such as miniature gears and biomedical devices New chapter dedicated to the recycling of thermoplastics and the processing of renewable polymers Life-cycle assessment, a systematic method for determining whether recycling is appropriate and which form of recycling is optimal Rheology of polymers containing fibers Chapters feature problem sets, enabling readers to assess and reinforce their knowledge as they progress through the text. There are also special design problems throughout the text that reflect real-world polymer processing issues. A companion website features numerical subroutines as well as guidance for using MATLAB®, IMSL®, and Excel to solve the sample problems from the text. By providing both underlying theory and practical step-by-step guidance, Polymer Processing is recommended for students in chemical, mechanical, materials, and polymer engineering.

With Wiley's Enhanced E-Text, you get all the benefits of a downloadable, reflowable eBook with added resources to make your study time more effective. Fundamentals of Heat and Mass Transfer 8th Edition has been the gold standard of heat transfer pedagogy for many decades, with a commitment to continuous improvement by four authors' with more than 150 years of combined experience in heat transfer education, research and practice. Applying the rigorous and systematic problem-solving methodology that this text pioneered an abundance of examples and problems reveal the richness and beauty of the discipline. This edition makes heat and mass transfer more approachable by giving additional emphasis to fundamental concepts, while highlighting the relevance of two of today's most critical issues: energy and the environment.

Heat Transfer Engineering: Fundamentals and Techniques reviews the core mechanisms of heat transfer and provides modern methods to solve practical problems encountered by working practitioners, with a particular focus on developing engagement and motivation. The book reviews fundamental concepts in conduction, forced convection, free convection, boiling, condensation, heat exchangers and mass transfer succinctly and without unnecessary exposition. Throughout, copious examples drawn from current industrial practice are examined with an emphasis on problem-solving for interest and insight rather than the procedural approaches often adopted in courses. The book contains numerous important solved and unsolved problems, utilizing modern tools and computational sources wherever relevant. A subsection on common issues and recent advances is presented in each chapter, encouraging the reader to explore a greater diversity of problems. Reveals physical solutions alongside their application in practical problems, with an aim of generating interest from reality rather than dry exposition Reviews pertinent, contemporary computational tools, including emerging topics such as machine learning Describes the complexity of modern heat transfer in an engaging and conversational style, greatly adding to the uniqueness and accessibility of the book

Thermal Conductivity 28
A Heat Transfer Textbook
Partial Pipe Heating, a Novel Numerical Method, and Inverse Heat Conduction
Biological and Bioenvironmental Heat and Mass Transfer
A Practical Approach with EES CD

This book introduces the fundamental concepts of inverse heat transfer problems. It presents in detail the basic steps of four techniques of inverse heat transfer protocol, as a parameter estimation approach and as a function estimation approach. These techniques are then applied to the solution of the problems of practical engineering interest involving conduction, convection, and radiation. The text also introduces a formulation based on generalized coordinates for the solution of inverse heat conduction problems in two-dimensional regions.

Here is the only commercially published work to deal with the engineering problem of determining surface heat flux and temperature history based on interior temperature measurements. Provides the analytical techniques needed to arrive at otherwise difficult solutions, summarizing the findings of the last ten years. Topics include the steady state solution, Duhamel's Theorem, ill-posed problems, single future time step, and more.

The understanding and control of transport phenomena in materials processing play an important role in the improvement of conventional processes and in the development of new techniques. Computer modeling of these phenomena can be used effectively for this purpose. Although there are several books in the literature covering the analysis of heat tra

This substantially updated and augmented second edition adds over 200 pages of text covering and an array of newer developments in nanoscale thermal transport. In Nano/Microscale Heat Transfer, 2nd edition, Dr. Zhang expands his classroom-proven text to incorporate thermal conductivity spectroscopy, time-domain and frequency-domain thermoreflectance techniques, quantum size effect on specific heat, coherent phonon, minimum thermal conductivity, interface thermal conductance, thermal interface materials, 2D sheet materials and their unique thermal properties, soft materials, first-principles simulation, hyperbolic metamaterials, magnetic polaritons, and new near-field radiation experiments and numerical simulations. Informed by over 12 years use, the author's research experience, and feedback from teaching faculty, the book has been reorganized in many sections and enriched with more examples and homework problems. Solutions for selected problems are also available to qualified faculty via a password-protected website.• Substantially updates and augments the widely adopted original edition, adding over 200 pages and many new illustrations.• Incorporates student and faculty feedback from a decade of classroom use.• Elucidates concepts explained with many examples and illustrations.• Supports student application of theory with 300 homework problems.• Maximizes reader understanding of micro/nanoscale thermophysical properties and processes and how to apply them to thermal science and engineering.• Features MATLAB codes for working with size and temperature effects on thermal conductivity, specific heat of nanostructures, thin-film optics, RCWA, and near-field radiation.

Fundamental Principles of Heat Transfer
Heat Conduction Using Green's Functions
Fundamentals and Applications
Principles and Design
Principles Of Heat Transfer

Heat Transfer is a compulsory core course in the curriculum of almost all branches of engineering in several engineering and technical institutions and universities. An outcome of the lecture notes prepared by the author, this book has been prepared primarily for an introductroy course in Heat and Mass Transfer.

The content of this book covers several up-to-date approaches in the heat conduction theory such as inverse heat conduction problems, non-linear and non-classic heat conduction equations, coupled thermal and electromagnetic or mechanical effects and numerical methods for solving heat conduction equations as well. The book is comprised of 14 chapters divided into four sections. In the first section inverse heat conduction problems are discuss. The first two chapters of the second section are devoted to construction of analytical solutions of nonlinear heat conduction problems. In the last two chapters of this section wavelike solutions are attained.The third section is devoted to combined effects of heat conduction and electromagnetic interactions in plasmas or in pyroelectric material elastic deformations and hydrodynamics. Two chapters in the last section are dedicated to numerical methods for solving heat conduction problems.

Analytical Heat Transfer explains how to analyze and solve conduction, convection, and radiation heat transfer problems. It enables students to tackle complex engineering heat transfer problems prevalent in practice. Covering heat transfer in high-speed flows and unsteady highly turbulent flows, the book also discusses enhanced heat transfer in channels, heat transfer in rotating channels, numerical modeling for turbulent flow heat transfer, and thermally developing heat transfer in a circular tube. The second edition features new content on Duhamel's superposition method, Green's function method for transient heat conduction, finite-difference method for steady state and transient heat conduction in cylindrical coordinates, and laminar mixed convection. It includes two new chapters on laminar-to-turbulent transitional heat transfer and turbulent flow heat transfer enhancement, in addition to end-of-chapter problems. The book bridges the gap between basic heat transfer undergraduate courses and advanced heat transfer graduate courses for a single semester of intermediate heat transfer, advanced conduction/radiation heat transfer, or convection heat transfer. Features: Focuses on analyzing and solving classic heat transfer problems in conduction, convection, and radiation Covers 2-D and 3-D view factor evaluation, combined radiation with conduction and/or convection, and gas radiation optically thin and optically thick limits Features updated content and new chapters on mass and heat transfer analogy, thermally developing heat transfer in a circular tube, unsteady highly turbulent flows, enhanced heat transfer in channels, heat transfer in rotating channels, and numerical modeling for turbulent flow heat transfer Provides step-by-step mathematical formula derivations, analytical solution procedures, and demonstration examples Includes end-of-chapter problems with an accompanying Solutions Manual for instructors This book is ideal for undergraduate and graduate students studying basic heat transfer and advanced heat transfer.

This comprehensive book is a valuable and readable reference text and source for anyone who wishes to learn about food cooling applications and methods of analysis of the heat transfer during these applications.

Nano/Microscale Heat Transfer
Experimental Methods in Heat Transfer and Fluid Mechanics
A Problem Solving Approach
Ill-Posed Problems
Analytical Heat Transfer

The long-awaited revision of the bestseller on heat conduction Heat Conduction, Third Edition is an update of the classic text on heat conduction, replacing some of the coverage of numerical methods with content on micro- and nanoscale heat transfer. With an emphasis on the mathematics and underlying physics, this new edition has considerable depth and analytical rigor, providing a systematic framework for each solution scheme with attention to boundary conditions and energy conservation. Chapter coverage includes: Heat conduction fundamentals Orthogonal functions, boundary value problems, and the Fourier Series The separation of variables in the cylindrical coordinate system The separation of variables in the spherical coordinate system Solution of the heat equation for semi-infinite and infinite domains The use of Duhamel's theorem The use of Green's function for solution of heat conduction The use of the Laplace transform One-dimensional composite medium Moving heat source problems Phase-change problems Approximate analytic methods Integral-transform technique Heat conduction in anisotropic solids Introduction to microscale heat conduction In addition, new capstone examples are included in this edition and extensive problems, cases, and examples have been thoroughly updated. A solutions manual is also available. Heat Conduction is appropriate reading for students in mainstream courses of conduction heat transfer, students in mechanical engineering, and engineers in research and design functions throughout industry.

The Presentation Adopted In The Preparation Endeavors To Convey To The Student In A Simple Manner, A Physical Understanding Of The Processes By Which Heat Is Transmitted And Provide Him Or Her With The Tools Necessary To Get Quantitative Solutions To Engineering Problems Involving One Or More Of The Basic Modes Of Heat Flow.

Sufficient Material Has Been Included In The Text To Cater To The Requirements Of The Undergraduate Curriculum. Illustrations Pertaining To The Different Modes Of Heat Transfer And The Design Calculations Of Heat Exchangers Have Been Liberally Included In The Text.The Purpose Of This Book Is To Present A Basic Introduction To The Field Of Engineering Heat Transfer. The Book Begins With A Brief Presentation Of The Importance Of Heat Transfer In Chemical And Processing Industry And The Modes Of Heat Transfer. Chapter 2, Dealing With Conduction, Includes A Few Aspects Of Conduction Phenomenon, Analogy Between Heat Flow And Electricity Flow, Critical Thickness And Conduction With Internal Generation Of Heat. In Chapter 3, The Concept Of Film Coefficients Is Presented And The Relationship Between The Individual And Overall Heat Transfer Coefficients Are Dealt With. The Phenomenon Of Unsteady State Heat Transfer And The Methods Of Solving One Dimensional Transient Heat Conduction Problems Have Been Discussed In Chapter 4, Which Is On Unsteady State Heat Conduction. Also The Application Of Molecular Transport Theory To The Unsteady State Heat Conduction Is Included.In Chapter 5, Which Is On Convection, A General Basic Concept, The Application Of Dimensional Analysis In The Case Of Forced And Free Convection, The Heat Transfer From Fins, The Heat Transfer To Fluids In Laminar Flow Inside Tubes, Heat Transfer From Condensed Vapours And Boiling Heat Transfer Are Included. The Various Types Of Heat Exchangers, The Concept Of Capacity Ratios, The Effectiveness Of Heat Exchanger, The Log Mean Temperature Difference, The Number Of Transfer Units (Ntu) And Calculations Pertaining To Heat Exchanger Design And The Effectiveness-Ntu Relationship Have Been Discussed In Chapter 6, Which Bears The Title 'Industrial Heat Exchange Equipment'.In Chapter 7, Which Is On Thermal Energy Transfer By Radiation, The Basic Concepts And Theory Of Radiation Are Presented. In Chapter 8, Which Deals With Evaporation, The Basic Concepts And Definitions, Boiling Point Elevation, Types Of Evaporators, Single And Multiple Effect Evaporation, The Occurrence Of Heat Transfer In Evaporators And The Analysis Of Performance Calculations Of Multiple Effect Evaporators Are Discussed At Some Length. Chapter 9, The Final Chapter, Presents A Brief Review Of Heat Transfer Principles.
CD-ROM contains: the limited academic version of Engineering equation solver(EES) with homework problems.
Providing a foundation in heat and mass transport, this book covers engineering principles of heat and mass transfer. The author discusses biological content, context, and parameter regimes and supplies practical applications for biological and biomedical engineering, industrial food processing, environmental control, and waste management. The book contains end-of-chapter problems and sections highlighting key concepts and important terminology It offers cross-references for easy access to related areas and relevant formulas, as well as detailed examples of transport phenomena, and descriptions of physical processes. It covers mechanisms of diffusion, capillarity, convection, and dispersion.
Applications in Thermo-Fluids and Acoustics
Heat Transfer Engineering
Finite Elements for Engineers with ANSYS Applications
Inverse Heat Conduction
Fundamentals and Techniques
Covering theory and practical industry usage of the finite element method, this highly-illustrated step-by-step approach thoroughly introduces methods using ANSYS.
The boundary element method (BEM) is a modern numerical techniquewhich has enjoyed increasing popularity over the last two decades,and is now an established alternative to traditional computationalmethods of engineering analysis. The main advantage of the BEM isits unique ability to provide a complete solution in terms ofboundary values only, with substantial savings in modelling effort. This two-volume book set is designed to provide the readers with acomprehensive and up-to-date account of the boundary element methodand its application to solving engineering problems. Each volume isa self-contained book including a substantial amount of materialnot previously covered by other text books on the subject. Volume 1covers applications to heat transfer, acoustics, electrochemistryand fluid mechanics problems, while volume 2 concentrates on solidsand structures, describing applications to elasticity, plasticity,elastodynamics, fracture mechanics and contact analysis. The earlychapters are designed as a teaching text for final yearundergraduate courses. Both volumes reflect the experience of theauthors over a period of more than twenty years of boundary element research. This volume, Applications in Thermo-Fluids and Acoustics, provides acomprehensive presentation of the BEM from fundamentals to advancedengineering applications and encompasses: Steady and transient heat transfer Potential and viscous fluid flows Frequency and time-domain acoustics Corrosion and other electrochemical problems. A unique feature of this book is an in-depth presentation of BEMformulations in all the above fields, including detaileddiscussions of the basic theory, numerical algorithms and practicalengineering applications of the method. Written by an internationally recognised authority in the field,this is essential reading for postgraduates, researchers andpractitioners in civil, mechanical and chemical engineering andapplied mathematics.
Advanced Heat Transfer, Second Edition provides a comprehensive presentation of intermediate and advanced heat transfer, and a unified treatment including both single and multiphase systems. It provides a fresh perspective, with coverage of new emerging fields within heat transfer, such as solar energy and cooling of microelectronics. Conductive, radiative and convective modes of heat transfer are presented, as are phase change modes. Using the latest solutions methods, the text is ideal for the range of engineering majors taking a second-level heat transfer course/module, which enables them to succeed in later coursework in energy systems, combustion, and chemical reaction engineering.
This introduction to conduction heat transfer blends a description of the necessary mathematics with contemporary engineering applications. Examples include: heat transfer in manufacturing processes, the cooling of electronic equipment and heat transfer in various applications.
Heat Transfer Principles and Applications
Analytical Heat Diffusion Theory
Numerical Heat Transfer
The Boundary Element Method, Volume 1
A Modern Approach
This Second Edition for the standard graduate level course in conduction heat transfer has been updated and oriented more to engineering applications partnered with real-world examples. New features include: numerous grid generation--for finding solutions by the finite element method--and recently developed inverse heat conduction. Every chapter and reference has been updated and new exercise problems replace the old.
This textbook presents the classical treatment of the problems of heat transfer in an exhaustive manner with due emphasis on understanding of the physics of the problems. This emphasis will be especially visible in the chapters on convective heat transfer. Emphasis is also laid on the solution of steady and unsteady two-dimensional heat conduction problems. Another special feature of the book is a chapter on introduction to design of heat exchangers and their illustrative design problems. A simple and understandable treatment of gaseous radiation has been presented. A special chapter on flat plate solar air heater has been incorporated that covers mathematical modeling of the air heater. The chapter on mass transfer has been written looking specifically at the needs of the students of mechanical engineering. The book includes a large number and variety of solved problems with supporting line diagrams. A number of application-based examples have been incorporated where applicable. The end-of-chapter exercise problems are supplemented with stepwise answers. Though the book has been primarily designed to serve as a complete textbook for undergraduate and graduate students of mechanical engineering, it will also be useful for students of chemical, aerospace, automobile, production, and industrial engineering streams. The book fully covers the topics of heat transfer coursework and can also be used as an excellent reference for students preparing for competitive graduate examinations.
Analytical Heat Diffusion Theory ...
There have been significant changes in the academic environment and in the workplace related to computing. Further changes are likely to take place. At Rensselaer Polytechnic Institute, the manner in which the subject of heat transfer is presented is evolving so as to accommodate to and, indeed, to participate in, the changes. One obvious change has been the introduction of the electronic calcula tor. The typical engineering student can now evaluate logarithms, trigonomet ric functions, and hyperbolic functions accurately by pushing a button. Teaching techniques and text presentations designed to avoid evaluation of these functions or the need to look them up in tables with associated interpolation are no longer necessary. Similarly, students are increasingly proficient in the use of computers. At RPI, every engineering student takes two semesters of computing as a fresh man and is capable of applying the computer to problems he or she encoun ters. Every student is given personal time on the campus computer. In addition, students have access to personal computers. In some colleges, all engineering students are provided with personal computers, which can be applied to a variety of tasks.
A HEAT TRANSFER TEXTBOOK
Heat Conduction
Conduction Heat Transfer
Heat Transfer in Structures
Introduction to Heat Transfer
Experimental Methods in Heat Transfer and Fluid Mechanics focuses on how to analyze and solve the classic heat transfer and fluid mechanics measurement problems in one book. This work serves the need of graduate students and researchers looking for advanced measurement techniques for thermal, flow, and heat transfer engineering applications. The text focuses on analyzing and solving classic heat transfer and fluid mechanics measurement problems, emphasizing fundamental principles, measurement techniques, data presentation, and uncertainty analysis. Overall, the text builds a strong and practical background for solving complex engineering heat transfer and fluid flow problems. Features Provides students with an understandable introduction to thermal-fluid measurement Covers heat transfer and fluid mechanics measurements from basic to advanced methods Explains and compares various thermal-fluid experimental and measurement techniques Uses a step-by-step approach to explaining key measurement principles Gives measurement procedures that readers can easily follow and apply in the lab
TABLE OF CONTENTS Preface CHAPTER 1—INSULATION · Detecting Resin Pre-Gelation in Hydro Generator Stator Bar Insulation · Thermal Insulation Using Fullerenes · Determination of Thermal Conductivity of Insulating Gels Using the Inverse Heat Transfer Method · Thermodynamic Analysis of High-Temperature, Multilayer Thermal Insulations CHAPTER 2—COMPOSITES AND POROUS MATERIALS · Measurement of the Thermophysical Properties of Magnesia-Carbon Refractory Materials · Effect of Interfacial Separation on Composite Thermal Conductivity · Method for Analyzing Thermal Conductivity of Heterogeneous Materials · Heat Conduction in Ceramics: Pores, Cracks and Splat Boundaries · The Long-Term Thermal Performance of Foams having Non-Uniform Density · Analysis of Flash Diffusivity Experiments Performed on Semi-Porous Materials · Measurement of Thermophysical Properties of Porous Ceramic Blocks by the Flash Method CHAPTER 3—THERMAL EXPANSION · Technique for Volumetric Expansion of Liquids and Solids from 200–400K · Negative Thermal Expansion · Variation of the Linear Coefficient of Thermal Expansion of Polymers Subject to Tension and Compression CHAPTER 4—MODELLING · Repeated Reflections of Acoustic Phonons in Hexagonal Crystals · Measurement and Microstructure-Based Modeling of the Thermal Conductivity of Fire Resistive Materials · Reflection Effects on the Thermal Conductivity of Dielectric Crystals in the Boundary-Scattering Regime CHAPTER 5—GASES AND FLUIDS · Thermal Conductivity of Methane—Revised Correlation of Experimental Data CHAPTER 6—EXPERIMENTAL TECHNIQUES · Infrared Imaging during Hot Disk Thermal Conductivity Measurements · High-Temperature Guarded Hot Plate Apparatus—Control of Edge Heat Loss · Determination of the Thermal and Electrical Contact Resistances at Elevated Temperatures · Fabrication of a Guarded-Hot-Plate Apparatus for Use Over an Extended Temperature Range and in a Controlled Gas Atmosphere · Determining Thermal Properties of Low-Density Porous Materials Using a Transient Inverse Heat Transfer Approach · Effusivity Sensor Package (ESP) System for Process Monitoring and Control · Radiation Calorimeter for Measurement of Thermophysical Properties of Solids from 400 to 800 K · New Transient Hot Bridge Sensor to Measure the Thermal Conductivity · JANUS: High Temperature Transient Hot Bridge Sensor · Improved Transient Hot Strip Sensor Design by Means of FEM Simulations · Rumination on Design and Build of an ASTM D-5470 Thermal Interface Test Instrument · A Mathis Type Microprobe for Thermal Anisotropy Measurements · Modified Line Heat Source Technique for Measurement of Thermal Properties on Mars · Fast Measurements of Absolute Thermal Conductivity Excluding Thermal Contact Resistance · All-Optical Measurement of Local Thermal Diffusivity in Opaque and Transparent Liquids and Solids CHAPTER 7—APPLICATIONS · Thermophysical Properties of Tobacco and Cigarettes · Thermogravimetric Methods: Applications to Determination of Residual Moisture in Freeze-Dried Biological Products · Evaluation of Thermal Interface Materials Using the Modified Hot Wire Technique · The Significance of Thermal Conductivity on Nuclear Fuel Oxidation Modelling · Radiative Heat Transfer Across Sugarcane and Coconut Fiber CHAPTER 8—NANOMATERIALS · An Optimized Thermo-Reflectance Technique for Thermal Conductivity Measurements of Thin-Film Electronic Materials · Thermal Interface Control: Thermal Performance and Structural Correlations for a Microscale Composite with Dispersed Nanoscale Filler Material · Measurement of the Thermal Diffusivity of Metallic Thin Films: Sn, Mo, and Al0.97Ti0.03 Alloy · Heat Flow in Nanowires · Thermal Conductivity of Heat Spread Films: Effect of Film ·Thickness and Deposition Temperature · High-Temperature Guarded Hot Plate Apparatus: Optimal Locations ·of Circular Heaters · Thermal Conductivity Based on Modified Laser Flash Measurement CHAPTER 9—GENERAL · Measurement of Thermal Expansion of High Temperature Resistant Alloys · Laser Flash Thermal Diffusivity Measurements of Isotropic Graphite and Glass-Like Carbon · Influence of Free Electrons on Thermal Conductivity: Thomson Effect · Thermal Conductivity and Heat Capacity Measurements of Paraffin Embedded in a Porous Matrix · Preliminary Investigations on Some Potential Applications of Thermal Effusivity Measurements in the Animal Feed Industry · Mathematical Model of the Structure of Heterogeneous Materials with Interpenetrating Components Author Index Subject Index Closure
Fundamental Principles of Heat Transfer introduces the fundamental concepts of heat transfer: conduction, convection, and radiation. It presents theoretical developments and example and design problems and illustrates the practical applications of fundamental principles. The chapters in this book cover various topics such as one-dimensional and transient heat conduction, energy and turbulent transport, forced convection, thermal radiation, and radiant energy exchange. There are example problems and solutions at the end of every chapter dealing with design problems. This book is a valuable introductory course in heat transfer for engineering students.
Elementary Heat Transfer Analysis provides information pertinent to the fundamental aspects of the nature of transient heat conduction. This book presents a thorough understanding of the thermal energy equation and its application to boundary layer flows and confined and unconfined turbulent flows. Organized into nine chapters, this book begins with an overview of the use of heat transfer coefficients in formulating the flux condition at phase interface. This text then explains the specification as well as application of flux boundary conditions. Other chapters consider a derivation of the transient heat conduction equation. This book discusses as well the convective energy transport based on the understanding and application of the thermal energy equation. The final chapter deals with the study of the processes of heat transfer during boiling and condensation. This book is a valuable resource for Junior or Senior engineering students who are in an introductory course in heat transfer.
Thermal Expansion 16 : Joint Conferences : June 26-29, 2005, St. Andrews-by-the -Sea, New Brunswick, Canada
Computer Modelling of Heat and Fluid Flow in Materials Processing
Basic Research
Heat Transfer