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Electrodynamics of Continua I

Turbulence theory is one of the most intriguing parts of fluid mechanics and many outstanding scientists have tried to apply their knowledge to the development of the theory and to offer useful recommendations for solution of some practical problems. In this monograph the author attempts to integrate many specific approaches into the unified theory. The basic premise is the simple idea that a small eddy, that is an element of turbulent meso-structure, possesses its own dynamics as an object rotating with its own spin velocity and obeying the Newton dynamics of a finite body. A number of such eddies fills a coordinate cell, and the angular momentum balance has to be formulated for this spatial cell. If the cell coincides with a finite difference element at a numerical calculation and if the external length scale is large, this elementary volume can be considered as a differential one and a continuum parameterization has to be used. Nontrivial angular balance is a consequence of the asymmetrical Reynolds stress action at the oriented sides of an elementary volume. At first glance, the averaged dyad of velocity components is symmetrical, $\overline{v_i v_j} = \overline{v_j v_i}$. However, if averaging is performed over the plane with normal n_j , the principle of commutation is lost. As a result, the stress tensor asymmetry $\overline{v_i v_j} - \overline{v_j v_i}$ is determined by other factors that participate in the angular momentum balance. This is the only possibility to determine a stress in engineering.

Lecture Notes on Intermediate Fluid Mechanics

Praise for the Third Edition “Future mathematicians, scientists, and engineers should find the book to be an excellent introductory text for coursework or self-study as well as worth its shelf space for reference.” —MAA Reviews Applied Mathematics, Fourth Edition is a thoroughly updated and revised edition on the applications of modeling and analyzing natural, social, and technological processes. The book covers a wide range of key topics in mathematical methods and modeling and highlights the connections between mathematics and the applied and natural sciences. The Fourth Edition covers both standard and modern topics, including scaling and dimensional analysis; regular and singular perturbation; calculus of variations; Green’s functions and integral equations; nonlinear wave propagation; and stability and bifurcation. The book provides extended coverage of mathematical biology, including biochemical kinetics, epidemiology, viral dynamics, and parasitic disease. In addition, the new edition features: Expanded coverage on orthogonality, boundary value problems, and distributions, all of which are motivated by solvability and eigenvalue problems in elementary linear algebra Additional MATLAB® applications for computer algebra system calculations Over 300 exercises and 100 illustrations that demonstrate important concepts New examples of dimensional analysis and scaling along with new tables of dimensions and units for easy reference Review material, theory, and examples of ordinary differential equations New material on applications to quantum mechanics, chemical kinetics, and modeling diseases and viruses Written at an accessible level for readers in a wide range of scientific fields, Applied Mathematics, Fourth Edition is an ideal text for introducing modern and advanced techniques of applied mathematics to upper-undergraduate and graduate-level students in mathematics, science, and engineering. The book is also a valuable reference for engineers and scientists in government and industry.

Fracture Mechanics of Electromagnetic Materials

This book is the first of 2 special volumes dedicated to the memory of Gérard Maugin. Including 40 papers that reflect his vast field of scientific activity, the contributions discuss non-standard methods (generalized model) to demonstrate the wide range of subjects that were covered by this exceptional scientific leader. The topics range from micromechanical basics to engineering applications, focusing on new models and applications of well-known models to new problems. They include micro-macro aspects, computational endeavors, options for identifying constitutive equations, and old problems with incorrect or non-satisfying solutions based on the classical continua assumptions.

Fluid Mechanics

This is the second volume of a two-volume set presenting a unified approach to the electrodynamics of continua, based on the principles of contemporary continuum of physics. The first volume was devoted mainly to the development of the theory and applications to deformable solid media. This volume extends the developments of the first volume to richer and newer grounds. It contains discussions on fluid media, magnetohydrodynamics, eletrohydrodynamics and media with more complicated structures. With the discussion, in the last two chapters, of memory-dependent materials and non-local E-M theory, the authors account for the nonlocal effects arising from motions and fields of material points

at past times and at spatially distant points. This discussion is included here to stimulate further research in these important fields, which are presently in development stages. The second volume is self-contained and can be studied without the help of volume I. A section summarizing the constitutive equations and the underlying physical ideas, which were presented in more detail in the first volume, is included. This volume may be used as a basis for several graduate courses in engineering schools, applied mathematics and physics departments. It also contains fresh ideas and will stimulate further research in the directions the authors outline.

A First Course in General Relativity

This volume is written by Academician Sedov who is considered by many as the leading scientist in mechanics in the USSR. This latest fourth edition helps the reader in a relatively short time to master and acquire fully the essence of many geometrical and mechanical theories. Contents: Volume 1: Kinematics of a Deformable Medium Dynamic Concepts and Dynamic Equations of Continuum Mechanics The Closed Systems of Mechanical Equations for the Simplest Models of Continuous Media. Some Results from Tensor Analysis Basic Thermodynamic Concepts and Equations Basic Concepts and Equations of Electrodynamics On the Formulation of Problems in Continuum Mechanics Nonlinear Tensor Functions of Several Tensor Arguments Models of Continuous Media with Internal Degrees of Freedom Volume 2: Hydrodynamics Theory of Elasticity Theory of Plasticity Introduction to the Plane Problems of the Theory of Elasticity and the Theory of Cracks Readership: Scientists/researchers of mechanical engineering, applied physics and theoretical physicists.

Introduction to Relativistic Continuum Mechanics

The electrodynamics of continua is a branch of the physical sciences concerned with the interaction of electromagnetic fields with deformable bodies. Deformable bodies are considered to be continua endowed with continuous distributions of mass and charge. The theory of electromagnetic continua is concerned with the determination of deformations, motions, stress, and electromagnetic fields developed in bodies upon the applications of external loads. External loads may be of mechanical origin (e.g., forces, couples, constraints placed on the surface of the body, and initial and boundary conditions arising from thermal and other changes) and/or electromagnetic origin (e.g., electric, magnetic, and current fields). Because bodies of different constitutions respond to external stimuli in a different way, it is imperative to characterize properly the response functions relevant to a given class of continua. This is done by means of the constitutive theory. For example, an elastic dielectric responds to electromagnetic fields in a totally different way than a magnetic fluid. The present book is intended to present a unified approach to the subject matter, based on the principles of contemporary continuum physics.

Electrodynamics

This two-part text fills what has often been a void in the first-year graduate physics curriculum. Through its examination of particles and continua, it supplies a lucid

and self-contained account of classical mechanics — which in turn provides a natural framework for introducing many of the advanced mathematical concepts in physics. The text opens with Newton's laws of motion and systematically develops the dynamics of classical particles, with chapters on basic principles, rotating coordinate systems, lagrangian formalism, small oscillations, dynamics of rigid bodies, and hamiltonian formalism, including a brief discussion of the transition to quantum mechanics. This part of the book also considers examples of the limiting behavior of many particles, facilitating the eventual transition to a continuous medium. The second part deals with classical continua, including chapters on string membranes, sound waves, surface waves on nonviscous fluids, heat conduction, viscous fluids, and elastic media. Each of these self-contained chapters provides the relevant physical background and develops the appropriate mathematical techniques, and problems of varying difficulty appear throughout the text.

Continuum Mechanics

These two volumes contain chapters written by experts in such areas as bio and food rheology, polymer rheology, flow of suspensions, flow in porous media, electrorheological fluids, etc. Computational as well as analytical mathematical descriptions, involving appropriate constitutive equations deal with complex flow situations of industrial importance. This work is unique in that it brings together state of the art reviews and recent advances in a variety of areas, involving viscoelastic materials, in a desirable and timely manner.

Electrodynamics of Continua II

Modern computational techniques, such as the Finite Element Method, have, since their development several decades ago, successfully exploited continuum theories for numerous applications in science and technology. Although standard continuum methods based upon the Cauchy-Boltzmann continuum are still of great importance and are widely used, it increasingly appears that material properties stemming from microstructural phenomena have to be considered. This is particularly true for inhomogeneous load and deformation states, where lower-scale size effects begin to affect the macroscopic material response; something standard continuum theories fail to account for. Following this idea, it is evident that standard continuum mechanics has to be augmented to capture lower-scale structural and compositional phenomena, and to make this information accessible to macroscopic numerical simulations.

Recent Advances in the Mechanics of Structured Continua, 2000

This textbook provides a unified approach to acoustics and vibration suitable for use in advanced undergraduate and first-year graduate courses on vibration and fluids. The book includes thorough treatment of vibration of harmonic oscillators, coupled oscillators, isotropic elasticity, and waves in solids including the use of resonance techniques for determination of elastic moduli. Drawing on 35 years of experience teaching introductory graduate acoustics at the Naval Postgraduate

School and Penn State, the author presents a hydrodynamic approach to the acoustics of sound in fluids that provides a uniform methodology for analysis of lumped-element systems and wave propagation that can incorporate attenuation mechanisms and complex media. This view provides a consistent and reliable approach that can be extended with confidence to more complex fluids and future applications. Understanding Acoustics opens with a mathematical introduction that includes graphing and statistical uncertainty, followed by five chapters on vibration and elastic waves that provide important results and highlight modern applications while introducing analytical techniques that are revisited in the study of waves in fluids covered in Part II. A unified approach to waves in fluids (i.e., liquids and gases) is based on a mastery of the hydrodynamic equations. Part III demonstrates extensions of this view to nonlinear acoustics. Engaging and practical, this book is a must-read for graduate students in acoustics and vibration as well as active researchers interested in a novel approach to the material.

Classical Mechanics

This collection of 17 papers from the November 2000 conference covers flows of non-Newtonian fluids, turbulent flows of fluids, mechanics of granular materials, the mechanics of mixtures, crystallization of polymers, traditional plasticity and other aspects concerning inelastic behavior of materials

Mechanics of Continuous Media

In their 1909 publication *Théorie des corps déformables*, Eugène and François Cosserat made a historic contribution to materials science by establishing the fundamental principles of the mechanics of generalized continua. The chapters collected in this volume showcase the many areas of continuum mechanics that grew out of the foundational work of the Cosserat brothers. The included contributions provide a detailed survey of the most recent theoretical developments in the field of generalized continuum mechanics and can serve as a useful reference for graduate students and researchers in mechanical engineering, materials science, applied physics and applied mathematics.

Classical Electrodynamics

Treats subjects directly related to nonlinear materials modeling for graduate students and researchers in physics, materials science, chemistry and engineering.

Theoretical Mechanics of Particles and Continua

Micropolar Fluids

Since it was first published in 1995, *Photonic Crystals* has remained the definitive text for both undergraduates and researchers on photonic band-gap materials and their use in controlling the propagation of light. This newly expanded and revised edition covers the latest developments in the field, providing the most up-to-date, concise, and comprehensive book available on these novel materials and their

applications. Starting from Maxwell's equations and Fourier analysis, the authors develop the theoretical tools of photonics using principles of linear algebra and symmetry, emphasizing analogies with traditional solid-state physics and quantum theory. They then investigate the unique phenomena that take place within photonic crystals at defect sites and surfaces, from one to three dimensions. This new edition includes entirely new chapters describing important hybrid structures that use band gaps or periodicity only in some directions: periodic waveguides, photonic-crystal slabs, and photonic-crystal fibers. The authors demonstrate how the capabilities of photonic crystals to localize light can be put to work in devices such as filters and splitters. A new appendix provides an overview of computational methods for electromagnetism. Existing chapters have been considerably updated and expanded to include many new three-dimensional photonic crystals, an extensive tutorial on device design using temporal coupled-mode theory, discussions of diffraction and refraction at crystal interfaces, and more. Richly illustrated and accessibly written, Photonic Crystals is an indispensable resource for students and researchers. Extensively revised and expanded Features improved graphics throughout Includes new chapters on photonic-crystal fibers and combined index-and band-gap-guiding Provides an introduction to coupled-mode theory as a powerful tool for device design Covers many new topics, including omnidirectional reflection, anomalous refraction and diffraction, computational photonics, and much more.

Angular Momentum in Geophysical Turbulence

This book proposes intriguing arguments that will enable students to achieve a deeper understanding of electromagnetism, while also presenting a number of classical methods for solving difficult problems. Two chapters are devoted to relativistic electrodynamics, covering all aspects needed for a full comprehension of the nature of electric and magnetic fields and, subsequently, electrodynamics. Each of the two final chapters examines a selected experimental issue, introducing students to the work involved in actually proving a law or theory. Classical books on electricity and magnetism are mentioned in many references, helping to familiarize students with books that they will encounter in their further studies. Various problems are presented, together with their worked-out solutions. The book is based on notes from special lectures delivered by the author to students during the second year of a BSc course in Physics, but the subject matter may also be of interest to senior physicists, as many of the themes covered are completely ignored or touched only briefly in standard textbooks.

Generalized Continua - from the Theory to Engineering Applications

Essential Advanced Physics is a series comprising four parts: Classical Mechanics, Classical Electrodynamics, Quantum Mechanics and Statistical Mechanics. Each part consists of two volumes, Lecture Notes and Problems with Solutions, further supplemented by an additional collection of test problems and solutions available to qualifying university instructors. Written for graduate and advanced undergraduate students, the goal of this series is to provide readers with a knowledge base necessary for professional work in physics, be that theoretical or

experimental, fundamental or applied research. From the formal point of view, it satisfies typical PhD basic course requirements at major universities. Selected parts of the series may be also valuable for graduate students and researchers in allied disciplines, including astronomy, chemistry, materials science, and mechanical, electrical, computer and electronic engineering. The EAP series is focused on the development of problem-solving skills. The following features distinguish it from other graduate-level textbooks: Concise lecture notes (250 pages per semester) Emphasis on simple explanations of the main concepts, ideas and phenomena of physics Sets of exercise problems, with detailed model solutions in separate companion volumes Extensive cross-referencing between the volumes, united by common style and notation Additional sets of test problems, freely available to qualifying faculty This volume, Classical Mechanics: Lecture Notes is intended to be the basis for a one-semester graduate-level course on classical mechanics and dynamics, including the mechanics of continua, in particular deformations, elasticity, waves, and fluid dynamics.

An Introduction to the Mechanics of Fluids

A compact, moderately general book which encompasses many fluid models of current interest The book is written very clearly and contains a large number of exercises and their solutions. The level of mathematics is that commonly taught to undergraduates in mathematics departments.. —Mathematical Reviews The book should be useful for graduates and researchers not only in applied mathematics and mechanical engineering but also in advanced materials science and technology Each public scientific library as well as hydrodynamics hand libraries should own this timeless book Everyone who decides to buy this book can be sure to have bought a classic of science and the heritage of an outstanding scientist. —Silikáty All applied mathematicians, mechanical engineers, aerospace engineers, and engineering mechanics graduates and researchers will find the book an essential reading resource for fluids. —Simulation News Europe

Microcontinuum Field Theories

This book begins with an introduction on continuum mechanics and a derivation of the linear partial differential equations for sound waves in fluids and elastic waves in solids. There is a brief chapter on the wave equations of electrodynamics. This is followed by a description of plane wave solutions and a discussion of concepts like reflection, refraction, polarization and the role of boundary conditions. The second part of the book deals with the theory and applications of distributions and Fourier transforms. Furthermore, dispersion, the method of stationary phase, Kramers-Kronig relations and various examples including surface waves on liquids are discussed. This text is unique because it emphasizes the use of distributions to analyze the solutions of the wave equation. The treatment of continuum mechanics is self-contained, as well as the discussion on distributions and Fourier transforms. In addition, many classical methods of theoretical physics are thoroughly discussed, e.g. the use of Green functions and multipole expansions.

The Dynamics and Thermodynamics of Compressible Fluid Flow

Micropolar fluids are fluids with microstructure. They belong to a class of fluids with nonsymmetric stress tensor that we shall call polar fluids, and include, as a special case, the well-established Navier-Stokes model of classical fluids that we shall call ordinary fluids. Physically, micropolar fluids may represent fluids consisting of rigid, randomly oriented (or spherical) particles suspended in a viscous medium, where the deformation of fluid particles is ignored. The model of micropolar fluids introduced in [65] by C. A. Eringen is worth studying as a very well balanced one. First, it is a well-founded and significant generalization of the classical Navier-Stokes model, covering, both in theory and applications, many more phenomena than the classical one. Moreover, it is elegant and not too complicated, in other words, man ageable to both mathematicians who study its theory and physicists and engineers who apply it. The main aim of this book is to present the theory of micropolar fluids, in particular its mathematical theory, to a wide range of readers. The book also presents two applications of micropolar fluids, one in the theory of lubrication and the other in the theory of porous media, as well as several exact solutions of particular problems and a numerical method. We took pains to make the presentation both clear and uniform.

Magnetohydrodynamics

Senior undergraduate and graduate textbook on key area in plasma physics and astrophysics.

Generalized Models and Non-classical Approaches in Complex Materials 1

This book delivers a thorough derivation of nonrelativistic interaction models of electromagnetic field theories with thermoelastic solids and viscous fluids, the intention being to derive unique representations for the observable field quantities. This volume is intended for and will be useful to students and researchers working on all aspects of electromagneto-mechanical interactions in the materials sciences of complex solids and fluids.

Finely Dispersed Particles

simulated motion on a computer screen, and to study the effects of changing parameters. --

Advances in Extended and Multifield Theories for Continua

This book presents a collection of chapters on the current problems of the theory of dynamical processes in generalized continua and structures, and has been compiled to commemorate the 70th birthday of Prof. Dmitry Indeitsev – a leading specialist in the field of dynamical processes in solids, fluids and structures. It discusses various applications related to Prof. Indeitsev’s contributions, including various discrete and continuous dynamic models of structures and media, as well as a number of dynamical processes in generalized media.

Electrodynamics of Continua II

The emphasis in this text is on classical electromagnetic theory and electrodynamics, that is, dynamical solutions to the Lorentz-force and Maxwell's equations. The natural appearance of the Minkowski spacetime metric in the paravector space of Clifford's geometric algebra is used to formulate a covariant treatment in special relativity that seamlessly connects spacetime concepts to the spatial vector treatments common in undergraduate texts. Baylis' geometrical interpretation, using such powerful tools as spinors and projectors, essentially allows a component-free notation and avoids the clutter of indices required in tensorial treatments. The exposition is clear and progresses systematically - from a discussion of electromagnetic units and an explanation of how the SI system can be readily converted to the Gaussian or natural Heaviside-Lorentz systems, to an introduction of geometric algebra and the paravector model of spacetime, and finally, special relativity. Other topics include Maxwell's equation(s), the Lorentz-force law, the Fresnel equations, electromagnetic waves and polarization, wave guides, radiation from accelerating charges and time-dependent currents, the Liénard-Wiechert potentials, and radiation reaction, all of which benefit from the modern relativistic approach. Numerous worked examples and exercises dispersed throughout the text help the reader understand new concepts and facilitate self-study of the material. Each chapter concludes with a set of problems, many with answers. Complete solutions are also available. An excellent feature is the integration of Maple into the text, thereby facilitating difficult calculations. To download accompanying Maple worksheets, please visit <http://www.cs.uwindsor.ca/users/b/baylis>

Waves And Distributions

This new, updated and enlarged edition of the successful and exceptionally well-structured textbook features new chapters on such hot topics as optical angular momentum, microscopy beyond the resolution limit, metamaterials, femtocombs, and quantum cascade lasers. It provides comprehensive and coherent coverage of fundamental optics, laser physics, and important modern applications, while equally including some traditional aspects for the first time, such as the Collins integral or solid immersion lenses. Written for newcomers to the topic who will benefit from the author's ability to explain difficult theories and effects in a straightforward and readily comprehensible way.

Continuum Mechanics and Thermodynamics

Second edition of a widely-used textbook providing the first step into general relativity for undergraduate students with minimal mathematical background.

Photonic Crystals

In their prior Dover book, the authors provided a self-contained account of classical mechanics; this supplement/update offers a bridge to contemporary mechanics. Topics include nonlinear continuous systems. 2006 edition.

Understanding Acoustics

This is the second volume of a two-volume set presenting a unified approach to the electrodynamics of continua, based on the principles of contemporary continuum of physics. The first volume was devoted mainly to the development of the theory and applications to deformable solid media. This volume extends the developments of the first volume to richer and newer grounds. It contains discussions on fluid media, magnetohydrodynamics, eletrohydrodynamics and media with more complicated structures. With the discussion, in the last two chapters, of memory-dependent materials and non-local E-M theory, the authors account for the nonlocal effects arising from motions and fields of material points at past times and at spatially distant points. This discussion is included here to stimulate further research in these important fields, which are presently in development stages. The second volume is self-contained and can be studied without the help of volume I. A section summarizing the constitutive equations and the underlying physical ideas, which were presented in more detail in the first volume, is included. This volume may be used as a basis for several graduate courses in engineering schools, applied mathematics and physics departments. It also contains fresh ideas and will stimulate further research in the directions the authors outline.

Solved Problems in Classical Mechanics

Over the last decade, the biggest advances in physical chemistry have come from thinking smaller. The leading edge in research pushes closer to the atomic frontier with every passing year. Collecting the latest developments in the science and engineering of finely dispersed particles and related systems, *Finely Dispersed Particles: Micro-, Nano-, and Atto-Engineering* explores heat, mass, momentum and electron transfer phenomena of well-characterized interfaces at the milli-, micro-, nano-, and atto-scales. An interdisciplinary team of leading experts from around the world discuss recent concepts in the physics and chemistry of various well-studied interfaces of rigid and deformable particles in homo- and hetero-aggregate dispersed systems, including emulsions, dispersoids, foams, fluosols, polymer membranes, and biocolloids. The contributors clearly elucidate the hydrodynamic, electrodynamic, and thermodynamic instabilities that occur at interfaces, as well as the rheological properties of interfacial layers responsible for droplets, particles, and droplet-particle-film structures in finely dispersed systems. The book examines structure and dynamics from various angles, such as relativistic and non-relativistic theories, molecular orbital methods, and transient state theories. With a comprehensive survey of our current understanding, *Finely Dispersed Particles: Micro-, Nano-, and Atto-Engineering* provides a solid platform for further exploration and discovery at increasingly smaller scales.

Dynamical Processes in Generalized Continua and Structures

Lecture Notes On Intermediate Fluid Mechanics By Joseph M. Powers

Optics, Light and Lasers

On the roots of continuum mechanics in differential geometry -- a review.- Cosserat media.- Cosserat-type shells.- Cosserat-type rods.- Micromorphic media.-

Electromagnetism and generalized continua.- Computational methods for generalized continua. The need of generalized continua models is coming from practice. Complex material behavior sometimes cannot be presented by the classical Cauchy continua. At present the attention of the scientists in this field is focused on the most recent research items • new models, • application of well-known models to new problems, • micro-macro aspects, • computational effort, and • possibilities to identify the constitutive equations The new research directions are discussed in this volume - from the point of view of modeling and simulation, identification, and numerical methods.

Mechanics of Generalized Continua

This book offers a broad overview of the potential of continuum mechanics to describe a wide range of macroscopic phenomena in real-world problems. Building on the fundamentals presented in the authors' previous book, *Continuum Mechanics using Mathematica®*, this new work explores interesting models of continuum mechanics, with an emphasis on exploring the flexibility of their applications in a wide variety of fields.

Nonlinear Mechanics

In this book we display the fundamental structure underlying classical electrodynamics, i. e. , the phenomenological theory of electric and magnetic effects. The book can be used as a textbook for an advanced course in theoretical electrodynamics for physics and mathematics students and, perhaps, for some highly motivated electrical engineering students. We expect from our readers that they know elementary electrodynamics in the conventional (1 + 3)-dimensional form including Maxwell's equations. More over, they should be familiar with linear algebra and elementary analysis, including vector analysis. Some knowledge of differential geometry would help. Our approach rests on the metric-free integral formulation of the conservation laws of electrodynamics in the tradition of F. Kottler (1922), E. Cartan (1923), and D. van Dantzig (1934), and we stress, in particular, the axiomatic point of view. In this manner we are led to an understanding of why the Maxwell equations have their specific form. We hope that our book can be seen in the classical tradition of the book by E. J. Post (1962) on the Formal Structure of Electromagnetics and of the chapter "Charge and Magnetic Flux" of the encyclopedia article on classical field theories by C. Truesdell and R. A. Toupin (1960), including R. A. Toupin's Bressanone lectures (1965); for the exact references see the end of the introduction on page 11. .

Principles of Magnetohydrodynamics

This mathematically-oriented introduction takes the point of view that students should become familiar, at an early stage, with the physics of relativistic continua and thermodynamics within the framework of special relativity. Therefore, in addition to standard textbook topics such as relativistic kinematics and vacuum electrodynamics, the reader will be thoroughly introduced to relativistic continuum and fluid mechanics. There is emphasis on the 3+1 splitting technique.

Electromagnetic Field Matter Interactions in Thermoelastic Solids and Viscous Fluids

Fluid Mechanics, Second Edition deals with fluid mechanics, that is, the theory of the motion of liquids and gases. Topics covered range from ideal fluids and viscous fluids to turbulence, boundary layers, thermal conduction, and diffusion. Surface phenomena, sound, and shock waves are also discussed, along with gas flow, combustion, superfluids, and relativistic fluid dynamics. This book is comprised of 16 chapters and begins with an overview of the fundamental equations of fluid dynamics, including Euler's equation and Bernoulli's equation. The reader is then introduced to the equations of motion of a viscous fluid; energy dissipation in an incompressible fluid; damping of gravity waves; and the mechanism whereby turbulence occurs. The following chapters explore the laminar boundary layer; thermal conduction in fluids; dynamics of diffusion of a mixture of fluids; and the phenomena that occur near the surface separating two continuous media. The energy and momentum of sound waves; the direction of variation of quantities in a shock wave; one- and two-dimensional gas flow; and the intersection of surfaces of discontinuity are also considered. This monograph will be of interest to theoretical physicists.

Advances in the Flow and Rheology of Non-Newtonian Fluids

Fracture Mechanics of Electromagnetic Materials provides a comprehensive overview of fracture mechanics of conservative and dissipative materials, as well as a general formulation of nonlinear field theory of fracture mechanics and a rigorous treatment of dynamic crack problems involving coupled magnetic, electric, thermal and mechanical field quantities. Thorough emphasis is placed on the physical interpretation of fundamental concepts, development of theoretical models and exploration of their applications to fracture characterization in the presence of magneto-electro-thermo-mechanical coupling and dissipative effects. Mechanical, aeronautical, civil, biomedical, electrical and electronic engineers interested in application of the principles of fracture mechanics to design analysis and durability evaluation of smart structures and devices will find this book an invaluable resource.

Interactions Between Electromagnetic Fields and Cells

Microcontinuum field theories extend classical field theories to microscopic spaces and short time scales. This volume is concerned with the kinematics of microcontinua. It begins with a discussion of strain, stress tensors, balance laws, and constitutive equations, and then discusses applications of the fundamental ideas to the theory of elasticity. The ideas developed here are important in modeling the fluid or elastic properties of porous media, polymers, liquid crystals, slurries, and composite materials.

Applied Mathematics

Foundations of Classical Electrodynamics

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