Lecture Notes On The Mechanics Of Elastic Solids Mit

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Finite Elasticity and Viscoelasticity - A D Drozdov 1996-01-11
This book provides a systematic and self-consistent introduction to the nonlinear continuum mechanics of solids, from the main axioms to comprehensive aspects of the theory.

The objective is to expose the most intriguing aspects of elasticity and viscoelasticity with finite strains in such a way as to ensure mathematical correctness, on the one hand, and to demonstrate a wide spectrum of physical phenomena typical only of nonlinear mechanics, on the other. A novel aspect of the book is that it contains a number of examples illustrating surprising behaviour in materials with finite strains, as well as comparisons between theoretical predictions and experimental data for rubber-like polymers and elastomers. The book aims to fill a gap between mathematicians specializing in nonlinear continuum mechanics, and physicists and engineers who apply the methods of solid mechanics to a wide range of problems in civil and mechanical engineering, materials science, and polymer physics. The book has been developed from a graduate course in applied mathematics which the author has given for a number of years. Contents:Tensor CalculusMechanics of ContinuaConstitutive Equations in Finite ElasticityBoundary Problems in Finite ElasticityVariational Principles in ElasticityConstitutive Models in Finite ViscoelasticityBoundary Problems in Finite Viscoelasticity Readership: Applied mathematicians. keywords:Cauchy Elasticity;Strain Energy Density;Tensor Calculus;Kinematics of Continua;Constitutive Theory;Green Elasticity;Hyperelasticity;Elastic Potentials;Existence;Uniqueness;Boundary Value Problems;Lagrange Principle;Stability;First Order "… a systematic and self-consistent introduction to the nonlinear continuum mechanics of solids, from the main axioms to comprehensive aspects of the theory … fills a gap between mathematicians specializing in nonlinear continuum mechanics, and physicists and engineers who apply the methods of solid mechanics to a wide range of problems in civil and mechanical engineering, materials science, and polymer physics." Lavoisier-Technique et Documentation "The text should be effective in

its intended role as a graduate-level introduction, as well as providing a source of applications and giving a basis for finding some details about the foundations of mechanics. Since there are few, if any, texts having attempted quite the aim of this book ... Finite Elasticity and Viscoelasticity can be considered a useful addition to many libraries." Appl Mech Rev "The textbook includes many exercises of different levels of complexity, which makes the lecture very attractive. The book can be recommended to researchers and students interested in modelling and mathematical problems of nonlinear mechanics of solids." Mathematical Reviews

Topics in Finite Elasticity - Michael Hayes 2014-05-04

More than fifty years ago, Professor R. S. Rivlin pioneered developments in both the theory and experiments of rubber elasticity. These together with his other fundamental studies contributed to a revitalization of the theory of finite elasticity, which had been dormant, since the basic understanding was completed in the nineteenth century. This book with chapters on foundation, models, universal results, wave propagation, qualitative theory and phase transitions, indicates that the subject he reinvigorated has remainded remarkably vibran and has continued to present significant deep mathematical and experimental challenges.

A Course in Elasticity - B. M. Fraeijs de Veubeke 2012-12-06

This book is based on lecture notes of the late Professor de Veubeke. The subject is presented at a level suitable for graduate students in engineering, physics, or mathematics. Some exposure to linear algebra, complex analysis, variational calculus, or basic continuum mechanics would be helpful. The first third of the book contains the fundamentals of the theory of elasticity. Kinematics of continuous media, the notions of stress and equilibrium, conservation of energy, 'and the elastic constitutive law are

each treated first in a nonlinear context, then specialized to the linear case. The remainder of the book is given to three classic applications of the theory, each supplemented by original re sults based on the use of complex variables. Each one of the three topics - Saint-Venant's theory of prismatic beams, plane deformations, and the bending of plates - is first pre sented and analyzed in general, then rounded out with numerous specific and sometimes novel examples. The following notational conventions are generally in force, except where noted to the contrary: lower case boldface letters denote vectors or triples of Cartesian co ordinates, upper case boldface letters denote 3 x 3 matrices, repeated lower case Latin subscripts are summed over (1,2,3), and non-repeated lower case Latin subscripts are assumed to range over (1,2,3).

Mathematical Foundations of Elasticity - Jerrold E. Marsden 2012-10-25

Graduate-level study approaches mathematical foundations of three-dimensional elasticity using modern differential geometry and functional analysis. It presents a classical subject in a modern setting, with examples of newer mathematical contributions. 1983 edition.

Advances in Mechanical Engineering - Alexander N. Evgrafov 2020-11-11

This book draws together the most interesting recent results to emerge in mechanical engineering in Russia, providing a fascinating overview of the state of the art in the field in that country which will be of interest to a wide readership. A broad range of topics and issues in modern engineering are discussed, including dynamics of machines, materials engineering, structural strength, transport technologies, machinery quality and innovations. The book comprises selected papers presented at the 9th conference "Modern Engineering: Science and Education", held at the Peter the Great Saint Petersburg Polytechnic University in June 2020 with the support of the Russian Engineering

Union. The authors are experts in various fields of engineering, and all of the papers have been carefully reviewed. The book will be of interest to mechanical engineers, lecturers in engineering disciplines and engineering graduates.

Engineering Solid Mechanics - Abdel-Rahman A. Ragab 1998-12-22

Engineering Solid Mechanics bridges the gap between elementary approaches to strength of materials and more advanced, specialized versions on the subject. The book provides a basic understanding of the fundamentals of elasticity and plasticity, applies these fundamentals to solve analytically a spectrum of engineering problems, and introduces advanced topics of mechanics of materials - including fracture mechanics, creep, superplasticity, fiber reinforced composites, powder compacts, and porous solids. Text includes: stress and strain, equilibrium, and compatibility elastic stress-strain relations the elastic problem and the stress function approach to solving plane elastic problems applications of the stress function solution in Cartesian and polar coordinates Problems of elastic rods, plates, and shells through formulating a strain compatibility function as well as applying energy methods Elastic and elastic-plastic fracture mechanics Plastic and creep deformation Inelastic deformation and its applications This book presents the material in an instructive manner, suitable for individual self-study. It emphasizes analytical treatment of the subject, which is essential for handling modern numerical methods as well as assessing and creating software packages. The authors provide generous explanations, systematic derivations, and detailed discussions, supplemented by a vast variety of problems and solved examples. Primarily written for professionals and students in mechanical engineering, Engineering Solid Mechanics also serves persons in other fields of engineering, such as aerospace, civil, and

material engineering.

Fracture Mechanics - Alan T. Zehnder 2012-01-03

Fracture mechanics is a vast and growing field. This book develops the basic elements needed for both fracture research and engineering practice. The emphasis is on continuum mechanics models for energy flows and crack-tip stress- and deformation fields in elastic and elastic-plastic materials. In addition to a brief discussion of computational fracture methods, the text includes practical sections on fracture criteria, fracture toughness testing, and methods for measuring stress intensity factors and energy release rates. Class-tested at Cornell, this book is designed for students, researchers and practitioners interested in understanding and contributing to a diverse and vital field of knowledge.

Pavement Mechanics - Eyal Levenberg 2020-10-06

This book introduces purely mechanistic models that are of particular relevance to the pavement engineering profession. It commences with a short recap of basic mechanics concepts, and then delves into topics such as viscoelasticity, elastic half-space solutions, and mechanics of supported plates. Given that all pavement design and analysis approaches are founded on some mechanistic logic, the text essentially offers a universal and long-lasting reference to practitioners and engineering students.

The Mathematics and Mechanics of Biological Growth - Alain Goriely 2017-05-29

This monograph presents a general mathematical theory for biological growth. It provides both a conceptual and a technical foundation for the understanding and analysis of problems arising in biology and physiology. The theory and methods are illustrated on a wide range of examples and applications. A process of extreme complexity, growth plays a fundamental role in many biological processes and is considered to be the hallmark of life itself. Its

description has been one of the fundamental problems of life sciences, but until recently, it has not attracted much attention from mathematicians, physicists, and engineers. The author herein presents the first major technical monograph on the problem of growth since D'Arcy Wentworth Thompson's 1917 book On Growth and Form. The emphasis of the book is on the proper mathematical formulation of growth kinematics and mechanics. Accordingly, the discussion proceeds in order of complexity and the book is divided into five parts. First, a general introduction on the problem of growth from a historical perspective is given. Then, basic concepts are introduced within the context of growth in filamentary structures. These ideas are then generalized to surfaces and membranes and eventually to the general case of volumetric growth. The book concludes with a discussion of open problems and outstanding challenges. Thoughtfully written and richly illustrated to be accessible to readers of varying interests and background, the text will appeal to life scientists, biophysicists, biomedical engineers, and applied mathematicians alike.

Applied Mechanics of Solids - Allan F. Bower 2009-10-05

Modern computer simulations make stress analysis easy. As they continue to replace classical mathematical methods of analysis, these software programs require users to have a solid understanding of the fundamental principles on which they are based.Develop Intuitive Ability to Identify and Avoid Physically Meaningless PredictionsApplied Mechanics o

Mechanics of Elastic Composites - Nicolaie Dan Cristescu 2003-09-15

This is a comprehensive, reader-friendly treatment of the theory behind modern elastic composite materials. The treatment includes recently developed results and methods drawn from research papers published in Eastern Europe that until now were unavailable in many western countries. Among the book's many

notable features is the inclusion of more th
Mechanics of the 21st Century - Witold Gutkowski 2005-07-07
This volume contains the proceedings of the 21st International Congress of Theoretical and Applied Mechanics, ICTAM04, held in Warsaw, in August 2004. Full texts of 27 invited lectures are included. The book captures a snapshot view of the state-of-the-art in the field of contemporary mechanics and will be invaluable to engineers and scientists from a variety of disciplines with interest in the mechanical sciences. The importance of the influence of contemporary mechanics on other branches of sciences becomes evident by browsing through over 60 areas of interest selected as subjects of mini-symposia and pre-nominated sessions. The book gives clear evidence that "...the progress we have achieved together definitely places mechanics on one of the very top locations in the hierarchy of modern research disciplines – with tremendous impact on both our perception of the physical world and the means to implement new technologies so much improving the quality of our life." (M. Kleiber, Opening Speech).
Lecture Notes in Engineering - Kumbakonam Rajagopal 2022-11-14
Viscoelasticity is the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. This book presents a set of lecture notes that introduce the topic of viscoelasticity and linearized elasticity to graduate and senior undergradute students. These notes have been used by the author for many years to teach one of the top courses in the country on linearized elasticity.
Applied Elasticity - Stephen Timoshenko 1925

The Direct Integration Method for Elastic Analysis of Nonhomogeneous Solids - Yuriy Tokovyy 2021-02-01
The direct integration method (a general approach to analysis for boundary value problems of mathematical physics with no

implications for the potential functions of higher differential order) is presented in this book as a potential tool for the analysis of the elastic response of arbitrarily nonhomogeneous solids to thermal and force loadings. This method rests upon the correct integration of the local equilibrium equations, which results in an explicit relationship between the stress-tensor components and fundamental integral conditions of equilibrium for individual stresses, which can serve to assure the correctness of the solution and provide a simple verification of computational results. Making use of these relationships and conditions, which are irrespective of the material properties, allows for the reduction of the original elasticity and thermoelasticity problems for nonhomogeneous materials to integral equations of a second kind which implies the solution in a closed form. This feature makes the method efficient for the analysis of arbitrarily nonhomogeneous materials, among which the functionally graded materials are of particular interest for both academia and industry.

Micromechanics of Defects in Solids - T. Mura 1987-11-30

This book stems from a course on Micromechanics that I started about fifteen years ago at Northwestern University. At that time, micromechanics was a rather unfamiliar subject. Although I repeated the course every year, I was never convinced that my notes have quite developed into a final manuscript because new topics emerged constantly requiring revisions, and additions. I finally came to realize that if this is continued, then I will never complete the book to my total satisfaction. Meanwhile, T. Mori and I had coauthored a book in Japanese, entitled Micromechanics, published by Baifu-kan, Tokyo, in 1975. It received an extremely favorable response from students and re searchers in Japan. This encouraged me to go ahead and publish my course notes in their latest version, as this book, which contains

further development of the subject and is more comprehensive than the one published in Japanese. Micromechanics encompasses mechanics related to microstructures of materials. The method employed is a continuum theory of elasticity yet its applications cover a broad area relating to the mechanical behavior of materi als: plasticity, fracture and fatigue, constitutive equations, composite materi als, polycrystals, etc. These subjects are treated in this book by means of a powerful and unified method which is called the 'eigenstrain method. ' In particular, problems relating to inclusions and dislocations are most effectively analyzed by this method, and therefore, special emphasis is placed on these topics.

Anisotropic Elasticity - Paolo Vannucci 2017-07-10

This book presents a modern and unconventional introduction to anisotropy. The first part presents a general description of Anisotropic Elasticity theories while the second part focuses on the polar formalism: the theoretical bases and results are completely developed along with applications to design problems of laminated anisotropic structures. The book is based on lectures on anisotropy which have been held at Ecole Polytechnique in Paris.

Mechanics of Elastic Structures with Inclined Members - Chin Hao Chang 2010-11-25

This monograph presents the mechanics of vibration, buckling and bending of elastic structures with inclined members such as x-braced high rise frames and conical shells. More than giving detailed derivations of basic equations, Mechanics of Elastic Structures with Inclined Members is mainly oriented towards practical problem-solving. The book can be used as a textbook for graduate students concentrating on structural mechanics, or as a reference book for engineers and researchers in the fields of engineering mechanics, civil engineering, mechanical engineering, and

aerospace engineering.

Applied Mechanics Reviews - 1972

Numerical Assessments of Cracks in Elastic-Plastic Materials - Huang Yuan 2002-04-26

In this book a systematic discussion of crack problems in elastic-plastic materials is presented. The state of the art in fracture mechanics research and assessment of cracks is documented, with the help of analytic, asymptotic methods as well as finite element computations. After a brief introduction to fracture mechanics, the two-parameter concept for stationary cracks is studied in addition to the issues in three-dimensional crack fields under coupling with strong out-of-plane effects. Cracks along interfaces and crack growth problems under mixed mode conditions are also treated. A systematic study of stress singularities for different notches is accompanied by detailed finite element computations.

Contact Problems in Elasticity - N. Kikuchi 1988-01-01

The contact of one deformable body with another lies at the heart of almost every mechanical structure. Here, in a comprehensive treatment, two of the field's leading researchers present a systematic approach to contact problems. Using variational formulations, Kikuchi and Oden derive a multitude of new results, both for classical problems and for nonlinear problems involving large deflections and buckling of thin plates with unilateral supports, dry friction with nonclassical laws, large elastic and elastoplastic deformations with frictional contact, dynamic contacts with dynamic frictional effects, and rolling contacts. This method exposes properties of solutions obscured by classical methods, and it provides a basis for the development of powerful numerical schemes.

Mechanics and Physics of Structured Media - Igor Andrianov 2022-01-28

Mechanics and Physics of Structured Media:

Asymptotic and Integral Methods of Leonid Filshtinsky provides unique information on the macroscopic properties of various composite materials and the mathematical techniques key to understanding their physical behaviors. The book is centered around the arguably monumental work of Leonid Filshtinsky. His last works provide insight on fracture in electromagnetic-elastic systems alongside approaches for solving problems in mechanics of solid materials. Asymptotic methods, the method of complex potentials, wave mechanics, viscosity of suspensions, conductivity, vibration and buckling of functionally graded plates, and critical phenomena in various random systems are all covered at length. Other sections cover boundary value problems in fracture mechanics, two-phase model methods for heterogeneous nanomaterials, and the propagation of acoustic, electromagnetic, and elastic waves in a one-dimensional periodic two-component material. Covers key issues around the mechanics of structured media, including modeling techniques, fracture mechanics in various composite materials, the fundamentals of integral equations, wave mechanics, and more Discusses boundary value problems of materials, techniques for predicting elasticity of composites, and heterogeneous nanomaterials and their statistical description Includes insights on asymptotic methods, wave mechanics, the mechanics of piezo-materials, and more Applies homogenization concepts to various physical systems

Notes on Continuum Mechanics - Eduardo WV Chaves 2013-06-13

This publication is aimed at students, teachers, and researchers of Continuum Mechanics and focused extensively on stating and developing Initial Boundary Value equations used to solve physical problems. With respect to notation, the tensorial, indicial and Voigt notations have been used indiscriminately. The book is divided into twelve chapters with the following topics:

Tensors, Continuum Kinematics, Stress, The Objectivity of Tensors, The Fundamental Equations of Continuum Mechanics, An Introduction to Constitutive Equations, Linear Elasticity, Hyperelasticity, Plasticity (small and large deformations), Thermoelasticity (small and large deformations), Damage Mechanics (small and large deformations), and An Introduction to Fluids. Moreover, the text is supplemented with over 280 figures, over 100 solved problems, and 130 references.

Mechanics and Electrodynamics of Magneto- and Electro-elastic Materials - Raymond Ogden 2011-05-25

This volume presents a state-of-the-art overview of the continuum theory of both electro- and magneto-sensitive elastomers and polymers, which includes mathematical and computational aspects of the modelling of these materials from the point of view of material properties and, in particular, the "smart-material" control of their mechanical properties.

Matrix Analysis of Discrete Elastic Systems - Hayrettin Kardestuncer 1980-12-31

Nonlinear Theory of Dislocations and Disclinations in Elastic Bodies - Leonid M. Zubov 2008-09-11

The author applies methods of nonlinear elasticity to investigate the defects in the crystal structure of solids such as dislocations and disclinations that characterize the plastic and strength properties of many materials. Contrary to the geometrically motivated nonlinear theory of dislocations continuously distributed over the body, nonlinear analysis of isolated dislocations and disclinations is less developed; it is given for the first time in this book, and in a form accessible to both students and researchers. The general theory of Volterra's dislocations in elastic media under large deformations is developed. A number of exact solutions are found. The nonlinear approach to investigating the isolated defects produces results that often

differ qualitatively from those of the linear theory.

Mechanics of Materials Volume 1 - E.J. Hearn 1997-07-09

One of the most important subjects for any student of engineering to master is the behaviour of materials and structures under load. The way in which they react to applied forces, the deflections resulting and the stresses and strains set up in the bodies concerned are all vital considerations when designing a mechanical component such that it will not fail under predicted load during its service lifetime. All the essential elements of a treatment of these topics are contained within this course of study, starting with an introduction to the concepts of stress and strain, shear force and bending moments and moving on to the examination of bending, shear and torsion in elements such as beams, cylinders, shells and springs. A simple treatment of complex stress and complex strain leads to a study of the theories of elastic failure and an introduction to the experimental methods of stress and strain analysis. More advanced topics are dealt with in a companion volume - Mechanics of Materials 2. Each chapter contains a summary of the essential formulae which are developed in the chapter, and a large number of worked examples which progress in level of difficulty as the principles are enlarged upon. In addition, each chapter concludes with an extensive selection of problems for solution by the student, mostly examination questions from professional and academic bodies, which are graded according to difficulty and furnished with answers at the end. * Emphasis on practical learning and applications, rather than theory * Provides the essential formulae for each individual chapter * Contains numerous worked examples and problems

Nonlinear Elasticity - London Mathematical Society 2001-05-07

Comprehensive introduction to nonlinear elasticity for graduates and researchers,

covering new developments in the field.

Classical Mechanics - Reinhard Hentschke 2016-12-30

This textbook teaches classical mechanics as one of the foundations of physics. It describes the mechanical stability and motion in physical systems ranging from the molecular to the galactic scale. Aside from the standard topics of mechanics in the physics curriculum, this book includes an introduction to the theory of elasticity and its use in selected modern engineering applications, e.g. dynamic mechanical analysis of viscoelastic materials. The text also covers many aspects of numerical mechanics, ranging from the solution of ordinary differential equations, including molecular dynamics simulation of many particle systems, to the finite element method. Attendant Mathematica programs or parts thereof are provided in conjunction with selected examples. Numerous links allow the reader to connect to related subjects and research topics. Among others this includes statistical mechanics (separate chapter), quantum mechanics, space flight, galactic dynamics, friction, and vibration spectroscopy. An introductory chapter compiles all essential mathematical tools, ranging from coordinates to complex numbers. Completely solved problems and examples facilitate a thorough understanding of the material.

A Treatise on the Mathematical Theory of Elasticity - Augustus Edward Hough Love 1944-01-01

The most complete single-volume treatment of classical elasticity, this text features extensive editorial apparatus, including a historical introduction. Topics include stress, strain, bending, torsion, gravitational effects, and much more. 1927 edition.

Micromechanics - S. Nemat-Nasser 2013-10-22

A comprehensive overview is given in this book towards a fundamental understanding of the micromechanics of the overall response and failure modes of advanced materials, such as

ceramics and ceramic and other composites. These advanced materials have become the focus of systematic and extensive research in recent times. The book consists of two parts. The first part reviews solids with microdefects such as cavities, cracks, and inclusions, as well as elastic composites. To render the book self-contained, the second part focuses on the fundamentals of continuum mechanics, particularly linear elasticity which forms the basis for the development of small deformation micromechanics. In Part 1, a fundamental and general framework for quantitative, rigorous analysis of the overall response and failure modes of microstructurally heterogeneous solids is systematically developed. These expressions apply to broad classes of materials with inhomogeneities and defects. While for the most part, the general framework is set within linear elasticity, the results directly translate to heterogeneous solids with rate-dependent or rate-independent inelastic constituents. This application is specifically referred to in various chapters. The general exact correlations obtained between the overall properties and the microstructure are then used together with simple models, to develop techniques for direct quantitative evaluation of the overall response which is generally described in terms of instantaneous overall moduli or compliance. The correlations among the corresponding results for a variety of problems are examined in great detail. The bounds as well as the specific results, include new observations and original developments, as well as an in-depth account of the state of the art. Part 2 focuses on Elasticity. The section on variational methods includes some new elements which should prove useful for application to advanced modeling, as well as solutions of composites and related heterogeneous bodies. A brief modern version of elements in vector and tensor algebra is provided which is particularly tailored to provide a background for the rest of this book. The data

contained in this volume as Part 1 includes new results on many basic issues in micromechanics, which will be helpful to graduate students and researchers involved with rigorous physically-based modeling of overall properties of heterogeneous solids.

Lecture Notes on Newtonian Mechanics - Ilya L. Shapiro 2013-08-15

One could make the claim that all branches of physics are basically generalizations of classical mechanics. It is also often the first course which is taught to physics students. The approach of this book is to construct an intermediate discipline between general courses of physics and analytical mechanics, using more sophisticated mathematical tools. The aim of this book is to prepare a self-consistent and compact text that is very useful for teachers as well as for independent study.

The Breadth and Depth of Continuum Mechanics - Constantine M. Dafermos 2012-12-06

This volume collects papers dedicated to Jerry Ericksen on his sixtieth birthday, December 20, 1984. They first appeared in Volumes 82-90 (1983-1985) of the Archive for Rational Mechanics and Analysis. At the request of the Editors the list of authors to be invited was drawn up by C. M. Dafermos, D. D. Joseph, and F. M. Leslie. The breadth and depth of the works here reprinted reflect the corresponding qualities in Jerry Ericksen's research, teaching, scholarship, and inspiration. His interests and expertness center upon the mechanics of materials and extend to everything that may contribute to it: pure analysis, algebra, geometry, through all aspects of theoretical mechanics to fundamental experiment, all of these illumi nated by an intimate and deep familiarity with the sources, even very old ones. He is independent of school and contemptuous of party spirit; his generosity in giving away his ideas is renowned, but not everyone is capable of accepting what is offered. His writings are totally free of broad claims and attributions

beyond his own study. Some are decisive, some are prophetic, and all are forthright. His work has served as a beacon of insight and simple honesty in an age of ever more trivial and corrupt science. The authors of the memoirs in this volume are his students, colleagues, admirers, and (above all) his friends.

From Bulk to Structural Failure: Fracture of Hyperelastic Materials - Philipp Laurens Rosendahl 2020-12-01

This thesis investigates the fracture of nearly incompressible hyperelastic media. It covers the different characteristics of bulk material failure under dilatational or distortional loads and develops a unified description of the corresponding failure surface. It proposes a coupled strain and energy failure criterion for the assessment of notch-induced crack nucleation and presents a weak-interface-model that allows for efficient stress, strain and failure analyses of hyperelastic adhesive lap joints. Theoretical concepts for the measurement of fracture properties of nonlinear elastic materials are provided. The methodology is developed using two exemplary hyperelastic silicones, DOWSIL 993 Structural Glazing Sealant and DOWSIL Transparent Structural Silicone Adhesive, and is validated using large sets of experiments of different loading conditions.

Introduction to Contact Mechanics - Anthony C. Fischer-Cripps 2007-04-08

This book deals with the mechanics of solid bodies in contact, a subject intimately connected with such topics as fracture, hardness, and elasticity. Coverage begins with an introduction to the mechanical properties of materials, general fracture mechanics, and the fracture of brittle solids. It then provides a detailed description of indentation stress fields for both elastic and elastic-plastic contact. In addition, the book discusses the formation of Hertzian cone cracks in brittle materials, subsurface damage in ductile materials, and the meaning of hardness. Coverage concludes with an overview

of practical methods of indentation testing.

Mechanics and Thermomechanics of Rubberlike Solids - Guiseppe Saccomandi 2014-05-04

This work gives for the first time an interdisciplinary and deep approach to the mathematical modelling of rubber-like materials considering both the molecular and phenomenological point of views. It contains an introduction to the suitable numerical techniques and an overview of experimental techniques and data with a short survey on some industrial applications. Elastic and inelastic effects are discussed in details. The book is suitable for applied mathematicians, mechanical engineers, civil engineers, material scientists and polymer scientists.

Elastic-Plastic Mixed-Mode Fracture Criteria and Parameters - Valery N. Shlyannikov 2012-07-28

My wife Tatyana, daughter Mariya, son Alexandr It is well known that the mixed-mode conditions appear when the direction of the applied loading does not coincide with the orthogonal K,-Kn-Km space. In general, in the industrial practice the mixed-mode fracture and the mixed-mode crack growth are more likely to be considered the rule than the exception. Miller et al. considers that cracks can grow due to a mixture of processes (ductile and brittle), mechanisms (static, fatigue, creep) and loading modes (tension, torsion, biax ial/multiaxial). Additionally mixed-mode crack-extension can be affected by many other considerations such as artifact geometry (thin plates, thick shells, and the size, shape and orientation of the defect), environmental effects (temperature, gaseous and liquid surroundings), material state (crystallographic structure, heat treatment and route of manufacture) and stress conditions (out-of-phase and ran dom loading effects). The main feature of the mixed-mode fracture is that the crack growth would no longer take place in a self-similar manner and does not follow a universal trajec tory that is it will grow on a curvilinear path. There are

various fracture criteria, which predict the behavior of cracks in brittle and ductile materials loaded in combined modes. Linear elastic fracture mechanics (LEFM) criteria predict basi cally the same direction for crack propagation. Cracks in brittle materials have been shown to propagate normal to the maximum tangential stress. In ductile ma terials yielding occurs at the crack tip and LEFM is no longer applicable.

Configurational Mechanics of Materials - Reinhold Kienzler 2001-07-19

These lecture notes cover numerous elements of configurational mechanics, including mathematical foundations, linear and nonlinear elasticity and continuum mechanics, coupled fields, fracture mechanics, as well as strength of materials.

Lectures in Classical Mechanics - Victor Ilisie 2020-02-05

This exceptionally well-organized book uses solved problems and exercises to help readers understand the underlying concepts of classical mechanics; accordingly, many of the exercises included are of a conceptual rather than practical nature. A minimum of necessary background theory is presented, before readers are asked to solve the theoretical exercises. In this way, readers are effectively invited to discover concepts on their own. While more practical exercises are also included, they are always designed to introduce readers to something conceptually new. Special emphasis is placed on important but often-neglected concepts such as symmetries and invariance, especially when introducing vector analysis in Cartesian and curvilinear coordinates. More difficult concepts, including non-inertial reference frames, rigid body motion, variable mass systems, basic tensorial algebra, and calculus, are covered in detail. The equations of motion in non-inertial reference systems are derived in two independent ways, and alternative deductions of the equations of motion

for variable mass problems are presented. Lagrangian and Hamiltonian formulations of mechanics are studied for non-relativistic cases, and further concepts such as inertial reference frames and the equivalence principle are introduced and elaborated on.

Waves and Rays in Elastic Continua - Michael A. Slawinski 2010

This is the second edition of the textbook that was first published by Elsevier Science. Professor Slawinski has the copyright to the textbook and the second edition is significantly extended. The present book emphasizes the interdependence of mathematical formulation and physical meaning in the description of seismic phenomena. Herein, we use aspects of continuum mechanics, wave theory and ray theory to explain phenomena resulting from the propagation of seismic waves. The book is divided into three main sections: elastic continua, waves and rays and variational formulation of rays. There is also a fourth part, which consists of appendices. In Part 1, we use continuum mechanics to describe the material through which seismic waves propagate, and to formulate a system of equations to study the behaviour of such a material. In Part 2, we use these equations to identify the types of body waves propagating in elastic continua as well as to express their velocities and displacements in terms of the properties of these continua. To solve the equations of motion in anisotropic inhomogeneous continua, we use the high-frequency approximation and, hence, establish the concept of a ray. In Part 3, we show that, in elastic continua, a ray is tantamount to a trajectory along which a seismic signal propagates in accordance with the variational principle of stationary traveltime. Consequently, many seismic problems in elastic continua can be conveniently formulated and solved using the calculus of variations. In Part 4, we describe two mathematical concepts that are used in the book; namely, homogeneity of a function and

Legendre's transformation. This section also contains a list of symbols.