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Classical and Quantum Physics - G. Marmo 2019-10-26
This proceedings is based on the interdisciplinary workshop held in Madrid, 5-9 March 2018, dedicated to Alberto Ibort on his 60th birthday. Alberto has great and significantly contributed to many fields of mathematics and physics, always with highly original and innovative ideas.Most of Albertos’s scientific activity has been motivated by geometric ideas, concepts and tools that are deeply related to the framework of classical dynamics and quantum mechanics.Let us mention some of the fields of expertise of Alberto Ibort:Geometric Mechanics; Constrained Systems; Variational Principles; Multisymplectic structures for field theories; Super manifolds; Inverse problem for Bosonic and Fermionic systems; Quantum Groups, Integrable systems, BRST Symmetries; Implicit differential equations; Yang-Mills Theories; BiHamiltonian Systems; Topology Change and Quantum Boundary Conditions; Classical and Quantum Control; Orthogonal Polynomials; Quantum Field Theory and Noncommutative Spaces; Classical and Quantum Tomography; Quantum Mechanics on phase space; Wigner-Weyl formalism; Lie-Jordan Algebras, Classical and Quantum; Quantum-to-Classical transition; Contraction of Associative Algebras; contact geometry, among many others.In each contribution, one may find not only technical novelties but also completely new way of looking at the considered problems. Even an experienced reader, reading Alberto's contributions on his field of expertise, will find new perspectives on the considered topic.His enthusiasm is happily contagious, for this reason he has had, and still has, very bright students wishing to elaborate their PhD thesis under his guidance.What is more impressive, is the broad list of rather different topics on which he has contributed.

A Student's Guide to Lagrangians and Hamiltonians - Patrick Hamill 2014
A concise treatment of variational techniques, focussing on Lagrangian and Hamiltonian systems, ideal for physics, engineering and mathematics students.

Classical Mechanics with Calculus of Variations and Optimal Control - Mark Levi 2014-03-07
This is an intuitively motivated presentation of many topics in classical mechanics and related areas of control theory and calculus of variations. All topics throughout the book are treated with zero tolerance for unrevealing definitions and for proofs which leave the reader in the dark.

Some areas of particular interest are: an extremely short derivation of the ellipticity of planetary orbits; a statement and an explanation of the "tennis racket paradox"; a heuristic explanation (and a rigorous treatment) of the gyroscopic effect; a revealing equivalence between the dynamics of a particle and statics of a spring; a short geometrical explanation of Pontryagin's Maximum Principle, and more. In the last chapter, aimed at more advanced readers, the Hamiltonian and the momentum are compared to forces in a certain static problem. This gives a palpable physical meaning to some seemingly abstract concepts and theorems. With minimal prerequisites consisting of basic calculus and basic undergraduate physics, this book is suitable for courses from an undergraduate to a beginning graduate level, and for a mixed audience of mathematics, physics and engineering students. Much of the enjoyment of the subject lies in solving almost 200 problems in this book.

Differential Geometry, Calculus of Variations, and Their Applications - George M. Rassias 1985-10-01

This book contains a series of papers on some of the longstanding research problems of geometry, calculus of variations, and their applications. It is suitable for advanced graduate students, teachers, research mathematicians, and other professionals in mathematics.

The Hamilton-Jacobi Theory in the Calculus of Variations - Hanno Rund 1966

Classical And Modern Optimization - Guillaume Carlier 2022-03-16

The quest for the optimal is ubiquitous in nature and human behavior. The field of mathematical optimization has a long history and remains active today, particularly in the development of machine learning.Classical and Modern Optimization presents a self-contained overview of classical and modern ideas and methods in approaching optimization problems. The approach is rich and flexible enough to address smooth and non-smooth, convex and non-convex, finite or infinite-dimensional, static or dynamic situations. The first chapters of the book are devoted to the classical toolbox: topology and functional analysis, differential calculus, convex analysis and necessary conditions for differentiable constrained optimization. The remaining chapters are dedicated to more specialized topics and applications.Valuable to a wide audience, including students in mathematics, engineers, data scientists or economists, Classical and Modern Optimization contains more than 200 exercises to assist with self-study or for anyone teaching a third- or fourth-year optimization class.

Global Formulations of Lagrangian and Hamiltonian Dynamics on Manifolds - Taeyoung Lee 2017-08-14

This book provides an accessible introduction to the variational formulation of Lagrangian and Hamiltonian mechanics, with a novel emphasis on global descriptions of the dynamics, which is a significant conceptual departure from more traditional approaches based on the use of local coordinates on the configuration manifold. In particular, we introduce a general methodology for obtaining globally valid equations of motion on configuration manifolds that are Lie groups, homogeneous spaces, and embedded manifolds, thereby avoiding the difficulties associated with coordinate singularities. The material is presented in an approachable fashion by considering concrete configuration manifolds of increasing complexity, which then motivates and naturally leads to the more general formulation that follows. Understanding of the material is enhanced by numerous in-depth examples throughout the book, culminating in non-trivial applications involving multi-body systems. This book is written for a general audience of mathematicians, engineers, and physicists with a basic knowledge of mechanics. Some basic background in differential geometry is helpful, but not essential, as the relevant concepts are introduced in the book, thereby making the material accessible to a broad audience, and suitable for either self-study or as the basis for a graduate course in applied mathematics, engineering, or physics.

Mathematics for Physical Science and Engineering - Frank E. Harris 2014-05-24

Mathematics for Physical Science and Engineering is a complete text in mathematics for physical science that includes the use of symbolic computation to illustrate the mathematical concepts and enable the

solution of a broader range of practical problems. This book enables professionals to connect their knowledge of mathematics to either or both of the symbolic languages Maple and Mathematica. The book begins by introducing the reader to symbolic computation and how it can be applied to solve a broad range of practical problems. Chapters cover topics that include: infinite series; complex numbers and functions; vectors and matrices; vector analysis; tensor analysis; ordinary differential equations; general vector spaces; Fourier series; partial differential equations; complex variable theory; and probability and statistics. Each important concept is clarified to students through the use of a simple example and often an illustration. This book is an ideal reference for upper level undergraduates in physical chemistry, physics, engineering, and advanced/applied mathematics courses. It will also appeal to graduate physicists, engineers and related specialties seeking to address practical problems in physical science. Clarifies each important concept to students through the use of a simple example and often an illustration Provides quick-reference for students through multiple appendices, including an overview of terms in most commonly used applications (Mathematica, Maple) Shows how symbolic computing enables solving a broad range of practical problems

An Introduction to Lagrangian Mechanics - Alain J Brizard 2014-11-28

An Introduction to Lagrangian Mechanics begins with a proper historical perspective on the Lagrangian method by presenting Fermat's Principle of Least Time (as an introduction to the Calculus of Variations) as well as the principles of Maupertuis, Jacobi, and d'Alembert that preceded Hamilton's formulation of the Principle of Least Action, from which the Euler–Lagrange equations of motion are derived. Other additional topics not traditionally presented in undergraduate textbooks include the treatment of constraint forces in Lagrangian Mechanics; Routh's procedure for Lagrangian systems with symmetries; the art of numerical analysis for physical systems; variational formulations for several continuous Lagrangian systems; an introduction to elliptic functions with applications in Classical Mechanics; and Noncanonical Hamiltonian Mechanics and perturbation theory. The Second Edition includes a larger selection of examples and problems (with hints) in each chapter and continues the strong emphasis of the First Edition on the development and application of mathematical methods (mostly calculus) to the solution of problems in Classical Mechanics. New material has been added to most chapters. For example, a new derivation of the Noether theorem for discrete Lagrangian systems is given and a modified Rutherford scattering problem is solved exactly to show that the total scattering cross section associated with a confined potential (i.e., which vanishes beyond a certain radius) yields the hard-sphere result. The Frenet-Serret formulas for the Coriolis-corrected projectile motion are presented, where the Frenet-Serret torsion is shown to be directly related to the Coriolis deflection, and a new treatment of the sleeping-top problem is given.

Variational Approach to Gravity Field Theories - Alberto Vecchiato 2017-05-30

This book offers a detailed and stimulating account of the Lagrangian, or variational, approach to general relativity and beyond. The approach more usually adopted when describing general relativity is to introduce the required concepts of differential geometry and derive the field and geodesic equations from purely geometrical properties. Demonstration of the physical meaning then requires the weak field approximation of these equations to recover their Newtonian counterparts. The potential downside of this approach is that it tends to suit the mathematical mind and requires the physicist to study and work in a completely unfamiliar environment. In contrast, the approach to general relativity described in this book will be especially suited to physics students. After an introduction to field theories and the variational approach, individual sections focus on the variational approach in relation to special relativity, general relativity, and alternative theories of gravity. Throughout the text, solved exercises and examples are presented. The book will meet the needs of both students specializing in theoretical physics and those seeking a better understanding of particular aspects of the subject.

Solved Problems in Lagrangian and Hamiltonian Mechanics - Claude

Gignoux 2009-07-14
The aim of this work is to bridge the gap between the well-known Newtonian mechanics and the studies on chaos, ordinarily reserved to experts. Several topics are treated: Lagrangian, Hamiltonian and Jacobi formalisms, studies of integrable and quasi-integrable systems. The chapter devoted to chaos also enables a simple presentation of the KAM theorem. All the important notions are recalled in summaries of the lectures. They are illustrated by many original problems, stemming from real-life situations, the solutions of which are worked out in great detail for the benefit of the reader. This book will be of interest to undergraduate students as well as others whose work involves mechanics, physics and engineering in general.
Introduction to Global Variational Geometry - Demeter Krupka 2015-01-13
The book is devoted to recent research in the global variational theory on smooth manifolds. Its main objective is an extension of the classical variational calculus on Euclidean spaces to (topologically nontrivial) finite-dimensional smooth manifolds; to this purpose the methods of global analysis of differential forms are used. Emphasis is placed on the foundations of the theory of variational functionals on fibered manifolds - relevant geometric structures for variational principles in geometry, physical field theory and higher-order fibered mechanics. The book chapters include: - foundations of jet bundles and analysis of differential forms and vector fields on jet bundles, - the theory of higher-order integral variational functionals for sections of a fibred space, the (global) first variational formula in infinitesimal and integral forms- extremal conditions and the discussion of Noether symmetries and generalizations,- the inverse problems of the calculus of variations of Helmholtz type- variational sequence theory and its consequences for the global inverse problem (cohomology conditions)- examples of variational functionals of mathematical physics. Complete formulations and proofs of all basic assertions are given, based on theorems of global analysis explained in the Appendix.
Calculus of Variations I - Mariano Giaquinta 2004-06-23
This two-volume treatise is a standard reference in the field. It pays special attention to the historical aspects and the origins partly in applied problems—such as those of geometric optics—of parts of the theory. It contains an introduction to each chapter, section, and subsection and an overview of the relevant literature in the footnotes and bibliography. It also includes an index of the examples used throughout the book.
New Lagrangian And Hamiltonian Methods In Field Theory - Giovanni Giachetta 1997-12-18
This book incorporates 3 modern aspects of mathematical physics: the jet methods in differential geometry, Lagrangian formalism on jet manifolds and the multimomentum approach to Hamiltonian formalism. Several contemporary field models are investigated in detail.This is not a book on differential geometry. However, modern concepts of differential geometry such as jet manifolds and connections are used throughout the book. Quadratic Lagrangians and Hamiltonians are studied at the general level including a treatment of Hamiltonian formalism on composite fiber manifolds. The book presents new geometric methods and results in field theory.
Stability Criteria for Fluid Flows - Adelina Georgescu 2010
1. Mathematical models governing fluid flows stability. 1.1. General mathematical models of thermodynamics. 1.2. Classical mathematical models in thermodynamics of fluids. 1.3. Classical mathematical models in thermodynamics. 1.4. Classical perturbation models. 1.5. Generalized incompressible Navier-Stokes model -- 2. Incompressible Navier-Stokes fluid. 2.1. Back to integral setting; involvement of dynamics and bifurcation. 2.2. Stability in semidynamical systems. 2.3. Perturbations; asymptotic stability; linear stability. 2.4. Linear stability. 2.5. Prodi's linearization principle. 2.6. Estimates for the spectrum of Ã. 2.7. Universal stability criteria -- 3. Elements of calculus of variations. 3.1. Generalities. 3.2. Direct and inverse problems of calculus of variations. 3.3. Symmetrization of some matricial ordinary differential operators. 3.4. Variational principles for problems (3.3.1)-(3.3.7). 3.5. Fourier series solutions for variational problems -- 4. Variants of the energy method for

non-stationary equations. 4.1. Variant based on differentiation of parameters. 4.2. Variant based on simplest symmetric part of operators. 4.3. Variants based on energy splitting -- 5. Applications to linear Bénard convections. 5.1. Magnetic Bénard convection in a partially ionized fluid. 5.2. Magnetic Bénard convection for a fully ionized fluid. 5.3. Convection in a micro-polar fluid bounded by rigid walls. 5.4. Convections governed by ode's with variable coefficients -- 6. Variational methods applied to linear stability. 6.1. Magnetic Bénard problem with Hall effect. 6.2. Lyapunov method applied to the anisotropic Bénard problem. 6.3. Stability criteria for a quasi-geostrophic forced zonal flow. 6.4. Variational principle for problem (5.3.1), (5.3.2). 6.5. Taylor-Dean problem -- 7. Applications of the direct method to linear stability. 7.1. Couette flow between two cylinders subject to a magnetic field. 7.2. Soret-Dufour driven convection. 7.3. Magnetic Soret-Dufour driven convection. 7.4. Convection in a porous medium. 7.5. Convection in the presence of a dielectrophoretic force. 7.6. Convection in an anisotropic M.H.D. thermodiffusive mixture. 7.7. Inhibition of the thermal convection by a magnetic field. 7.8. Microconvection in a binary layer subject to a strong Soret effect. 7.9. Convection in the layer between the sea bed and the permafrost.

Advanced Classical Field Theory - G. Giachetta 2009

Contemporary quantum field theory is mainly developed as quantization of classical fields. Therefore, classical field theory and its BRST extension is the necessary step towards quantum field theory. This book aims to provide a complete mathematical foundation of Lagrangian classical field theory and its BRST extension for the purpose of quantization. Based on the standard geometric formulation of theory of nonlinear differential operators, Lagrangian field theory is treated in a very general setting. Reducible degenerate Lagrangian theories of even and odd fields on an arbitrary smooth manifold are considered. The second Noether theorems generalized to these theories and formulated in the homology terms provide the strict mathematical formulation of BRST extended classical field theory. The most physically relevant field theories ? gauge theory on principal bundles, gravitation theory on natural bundles, theory of spinor fields and topological field theory ? are presented in a complete way.This book is designed for theoreticians and mathematical physicists specializing in field theory. The authors have tried throughout to provide the necessary mathematical background, thus making the exposition self-contained.

Handbook of Global Analysis - Demeter Krupka 2011-08-11

This is a comprehensive exposition of topics covered by the American Mathematical Society’s classification “Global Analysis , dealing with modern developments in calculus expressed using abstract terminology. It will be invaluable for graduate students and researchers embarking on advanced studies in mathematics and mathematical physics. This book provides a comprehensive coverage of modern global analysis and geometrical mathematical physics, dealing with topics such as; structures on manifolds, pseudogroups, Lie groupoids, and global Finsler geometry; the topology of manifolds and differentiable mappings; differential equations (including ODEs, differential systems and distributions, and spectral theory); variational theory on manifolds, with applications to physics; function spaces on manifolds; jets, natural bundles and generalizations; and non-commutative geometry. - Comprehensive coverage of modern global analysis and geometrical mathematical physics - Written by world-experts in the field - Up-to-date contents

Calculus of Variations II - Mariano Giaquinta 2004-06-30

This book by two of the foremost researchers and writers in the field is the first part of a treatise that covers the subject in breadth and depth, paying special attention to the historical origins of the theory. Both individually and collectively these volumes have already become standard references.

Analysis - Jean-Paul Penot 2016-12-18

This textbook covers the main results and methods of real analysis in a single volume. Taking a progressive approach to equations and transformations, this book starts with the very foundations of real analysis (set theory, order, convergence, and measure theory) before presenting powerful results that can be applied to concrete problems. In

addition to classical results of functional analysis, differential calculus and integration, Analysis discusses topics such as convex analysis, dissipative operators and semigroups which are often absent from classical treatises. Acknowledging that analysis has significantly contributed to the understanding and development of the present world, the book further elaborates on techniques which pervade modern civilization, including wavelets in information theory, the Radon transform in medical imaging and partial differential equations in various mechanical and physical phenomena. Advanced undergraduate and graduate students, engineers as well as practitioners wishing to familiarise themselves with concepts and applications of analysis will find this book useful. With its content split into several topics of interest, the book's style and layout make it suitable for use in several courses, while its self-contained character makes it appropriate for self-study.

Gravity, Particles and Space-Time - P I Pronin 1996-04-12

This volume comprises original and review articles on the frontier problems of the gravitation theory, theoretical and mathematical physics. The volume is dedicated to the memory of Professor Dmitri Ivanenko who made the great contribution to the physical science of the twentieth century. Contents:A Gauge-Invariant Theory of Motion of Charged Test Particles (D Chruscinski & J Kijowski)Heisenberg Picture for Quantized Fields Interacting with Nonstationary Electromagnetic or Gravitational Background (A A Lobashov & V M Mostepanenko)General Relativity as a Gauge Theory of Orthogonal Groups in Three Dimensions (M Raiteri et al.)Quantum Spacetime (D Finkelstein et al.)Jacobi's Principle and Hertz' Definition of Time (H-J Treder et al.)Placing Limits on Cartan's Torsion from Non-Riemannian Crystals (L C G de Andrade)Spinors as Differential Forms, and Applications to Electromagnetism and Quantum Mechanics (W A Rodrigues, Jr & J Vaz, Jr)Black Holes, Time Arrow, and Vacuum in Quantum Electrodynamics (M E Gertsenstein)One-Loop Background Calculations in the General Field Theory (P I Pronin & K V Stepanyantz)Energy–Momentum Superpotential in Gravitation Theory (G Giachetta & G Sardanashvily)and other papers Readership: Physicists, astronomists, high energy physicists, cosmologists and astrophysicists. keywords:Gravitation Theory;Riemannian Geometry;Gauge Theory;Spinor Field;Dirac Operator;Clifford Algebra;Torsion;Quantum Field;Black Hole;Conservation Law"… the book properly reflects the state of the art in a sector of current research on gravitation (and, less so, other fundamental interactions) and spacing geometry."H Goenner Classical and Quantum Gravity

A Monograph on the General Theory of Second Order Parameter-invariant Problems in the Calculus of Variations - H. S. P. Grässer 1967

Dynamical Systems and Microphysics - Andre Avez 2012-12-02

Dynamical Systems and Microphysics: Geometry and Mechanics contains the proceedings of the Second International Seminar on Mathematical Theory of Dynamical Systems and Microphysics held at the International Center for Mechanical Sciences in Udine, Italy on September 1-11, 1981. Contributors explore the geometry and mechanics of dynamical systems and microphysics and cover topics ranging from Lagrangian submanifolds and optimal control theory to Hamiltonian mechanics, linear dynamical systems, and the quantum theory of measurement. This volume is organized into six sections encompassing 30 chapters and begins with an introduction to geometric structures, mechanics, and general relativity. It considers an approach to quantum mechanics through deformation of the symplectic structure, giving a striking insight into the correspondence principle. The chapters that follow focus on the gauge invariance of the Einstein field, group treatment of the space of orbits in the Kepler problem, and stable configurations in nonlinear problems arising from physics. This book is intended for researchers and graduate students in theoretical physics, mechanics, control and system theory, and mathematics. It will also be profitably read by philosophers of science and, to some extent, by persons who have a keen interest in basic questions of contemporary mechanics and physics and some background in the physical and mathematical sciences.

Calculus of Variations - I. M. Gelfand 2012-04-26

Fresh, lively text serves as a modern introduction to the subject, with

applications to the mechanics of systems with a finite number of degrees of freedom. Ideal for math and physics students.

Mathematical Aspects of Classical Field Theory - Mark J. Gotay 1992

Classical field theory has undergone a renaissance in recent years. Symplectic techniques have yielded deep insights into its foundations, as has an improved understanding of the variational calculus. Further impetus for the study of classical fields has come from other areas, such as integrable systems, Poisson geometry, global analysis, and quantum theory. This book contains the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Mathematical Aspects of Classical Field Theory, held in July 1991 at the University of Washington at Seattle. The conference brought together researchers in many of the main areas of classical field theory to present the latest ideas and results. The volume contains thirty refereed papers, both survey and research articles, and is designed to reflect the state of the art as well as chart the future course of the subject.

Symplectic Geometry and Mathematical Physics - P. Donato 1991-12

This volume contains the proceedings of the conference "Colloque de Goometrie Symplectique et Physique Mathematique" which was held in Aix-en-Provence (France), June 11-15, 1990, in honor of Jean-Marie Souriau. The conference was one in the series of international meetings of the Seminaire Sud Rhodanien de Goometrie, an organization of geometers and mathematical physicists at the Universities of Avignon, Lyon, Mar seille, and Montpellier. The scientific interests of Souriau, one of the founders of geometric quantization, range from classical mechanics (symplectic geometry) and quantization problems to general relativity and astrophysics. The themes of this conference cover "only" the first two of these four areas. The subjects treated in this volume could be classified in the follow ing way: symplectic and Poisson geometry (Arms-Wilbour, Bloch-Ratiu, Brylinski-Kostant, Cushman-Sjamaar, Dufour, Lichnerowicz, Medina, Ouzilou), classical mechanics (Benenti, Holm-Marsden, Marle) , particles and fields in physics (Garcia Perez-Munoz Masque, Gotay, Montgomery, Ne'eman-Sternberg, Sniatycki) and quantization (Blattner, Huebschmann, Karasev, Rawnsley, Roger, Rosso, Weinstein). However, these subjects are so interrelated that a classification by headings such as "pure differential geometry, applications of Lie groups, constrained systems in physics, etc. ," would have produced a completely different clustering! The list of authors is not quite identical to the list of speakers at the conference. M. Karasev was invited but unable to attend; C. Itzykson and M. Vergne spoke on work which is represented here only by the title of Itzykson's talk (Surfaces triangulees et integration matricielle) and a summary of Vergne's talk.

The Philosophy and Physics of Noether's Theorems - James Read 2022-08-31

In 1918, Emmy Noether, in her paper Invariante Variationsprobleme, proved two theorems (and their converses) on variational problems that went on to revolutionise theoretical physics. 100 years later, the mathematics of Noether's theorems continues to be generalised, and the physical applications of her results continue to diversify. This centenary volume brings together world-leading historians, philosophers, physicists, and mathematicians in order to clarify the historical context of this work, its foundational and philosophical consequences, and its myriad physical applications. Suitable for advanced undergraduate and graduate students and professional researchers, this is a go-to resource for those wishing to understand Noether's work on variational problems and the profound applications which it finds in contemporary physics.

Optimal Control Systems - D. Subbaram Naidu 2018-10-03

The theory of optimal control systems has grown and flourished since the 1960's. Many texts, written on varying levels of sophistication, have been published on the subject. Yet even those purportedly designed for beginners in the field are often riddled with complex theorems, and many treatments fail to include topics that are essential to a thorough grounding in the various aspects of and approaches to optimal control. Optimal Control Systems provides a comprehensive but accessible treatment of the subject with just the right degree of mathematical rigor to be complete but practical. It provides a solid bridge between "traditional" optimization using the calculus of variations and what is

called "modern" optimal control. It also treats both continuous-time and discrete-time optimal control systems, giving students a firm grasp on both methods. Among this book's most outstanding features is a summary table that accompanies each topic or problem and includes a statement of the problem with a step-by-step solution. Students will also gain valuable experience in using industry-standard MATLAB and SIMULINK software, including the Control System and Symbolic Math Toolboxes. Diverse applications across fields from power engineering to medicine make a foundation in optimal control systems an essential part of an engineer's background. This clear, streamlined presentation is ideal for a graduate level course on control systems and as a quick reference for working engineers.

The Random-Cluster Model - Geoffrey R. Grimmett 2006-12-13

The random-cluster model has emerged as a key tool in the mathematical study of ferromagnetism. It may be viewed as an extension of percolation to include Ising and Potts models, and its analysis is a mix of arguments from probability and geometry. The Random-Cluster Model contains accounts of the subcritical and supercritical phases, together with clear statements of important open problems. The book includes treatment of the first-order (discontinuous) phase transition.

Noether's Theorems - Gennadi Sardanashvily 2016-03-18

The book provides a detailed exposition of the calculus of variations on fibre bundles and graded manifolds. It presents applications in such area's as non-relativistic mechanics, gauge theory, gravitation theory and topological field theory with emphasis on energy and energy-momentum conservation laws. Within this general context the first and second Noether theorems are treated in the very general setting of reducible degenerate graded Lagrangian theory.

Geometric Methods in Mathematical Physics - G. Kaiser 2006-11-14

For too many students, mathematics consists of facts in a vacuum, to be memorized because the instructor says so, and to be forgotten when the course of study is completed. In this all-too-common scenario, young learners often miss the chance to develop skills-specifically, reasoning skills-that can serve them for a lifetime. The elegant pages of Teaching Mathematical Reasoning in Secondary School Classrooms propose a more positive solution by presenting a reasoning- and discussion-based approach to teaching mathematics, emphasizing the connections between ideas, or why math works. The teachers whose work forms the basis of the book create a powerful record of methods, interactions, and decisions (including dealing with challenges and impasses) involving this elusive topic. And because this approach shifts the locus of authority from the instructor to mathematics itself, students gain a system of knowledge that they can apply not only to discrete tasks relating to numbers, but also to the larger world of people and the humanities. A sampling of the topics covered: Whole-class discussion methods for teaching mathematics reasoning. Learning mathematical reasoning through tasks. Teaching mathematics using the five strands. Classroom strategies for promoting mathematical reasoning. Maximizing student contributions in the classroom. Overcoming student resistance to mathematical conversations. Teaching Mathematical Reasoning in Secondary School Classrooms makes a wealth of cutting-edge strategies available to mathematics teachers and teacher educators. This book is an invaluable resource for researchers in mathematics and curriculum reform and of great interest to teacher educators and teachers.

A First Course in the Calculus of Variations - Mark Kot 2014-10-06

This book is intended for a first course in the calculus of variations, at the senior or beginning graduate level. The reader will learn methods for finding functions that maximize or minimize integrals. The text lays out important necessary and sufficient conditions for extrema in historical order, and it illustrates these conditions with numerous worked-out examples from mechanics, optics, geometry, and other fields. The exposition starts with simple integrals containing a single independent variable, a single dependent variable, and a single derivative, subject to weak variations, but steadily moves on to more advanced topics, including multivariate problems, constrained extrema, homogeneous problems, problems with variable endpoints, broken extremals, strong variations, and sufficiency conditions. Numerous line drawings clarify the mathematics. Each chapter ends with recommended readings that

introduce the student to the relevant scientific literature and with exercises that consolidate understanding.

Introduction to the Fractional Calculus of Variations - Agnieszka B. Malinowska 2012

This invaluable book provides a broad introduction to the fascinating and beautiful subject of Fractional Calculus of Variations (FCV). In 1996, FVC evolved in order to better describe non-conservative systems in mechanics. The inclusion of non-conservatism is extremely important from the point of view of applications. Forces that do not store energy are always present in real systems. They remove energy from the systems and, as a consequence, Noether's conservation laws cease to be valid. However, it is still possible to obtain the validity of Noether's principle using FCV. The new theory provides a more realistic approach to physics, allowing us to consider non-conservative systems in a natural way. The authors prove the necessary Euler Lagrange conditions and corresponding Noether theorems for several types of fractional variational problems, with and without constraints, using Lagrangian and Hamiltonian formalisms. Sufficient optimality conditions are also obtained under convexity, and Leitmann's direct method is discussed within the framework of FCV. The book is self-contained and unified in presentation. It may be used as an advanced textbook by graduate students and ambitious undergraduates in mathematics and mechanics. It provides an opportunity for an introduction to FCV for experienced researchers. The explanations in the book are detailed, in order to capture the interest of the curious reader, and the book provides the necessary background material required to go further into the subject and explore the rich research literature.

The Calculus of Variations - Bruce van Brunt 2006-04-18

Suitable for advanced undergraduate and graduate students of mathematics, physics, or engineering, this introduction to the calculus of variations focuses on variational problems involving one independent variable. It also discusses more advanced topics such as the inverse problem, eigenvalue problems, and Noether’s theorem. The text includes numerous examples along with problems to help students consolidate the material.

Mechanics, Analysis and Geometry: 200 Years after Lagrange - M. Francaviglia 2012-12-02

Providing a logically balanced and authoritative account of the different branches and problems of mathematical physics that Lagrange studied and developed, this volume presents up-to-date developments in differential goemetry, dynamical systems, the calculus of variations, and celestial and analytical mechanics.

Lagrangian and Hamiltonian Dynamics - Peter Mann 2018-05-10

An introductory textbook exploring the subject of Lagrangian and Hamiltonian dynamics, with a relaxed and self-contained setting. Lagrangian and Hamiltonian dynamics is the continuation of Newton's classical physics into new formalisms, each highlighting novel aspects of mechanics that gradually build in complexity to form the basis for almost all of theoretical physics. Lagrangian and Hamiltonian dynamics also acts as a gateway to more abstract concepts routed in differential geometry and field theories and can be used to introduce these subject areas to newcomers. Journeying in a self-contained manner from the very basics, through the fundamentals and onwards to the cutting edge of the subject, along the way the reader is supported by all the necessary background mathematics, fully worked examples, thoughtful and vibrant illustrations as well as an informal narrative and numerous fresh, modern and inter-disciplinary applications. The book contains some unusual topics for a classical mechanics textbook. Most notable examples include the 'classical wavefunction', Koopman-von Neumann theory, classical density functional theories, the 'vakonomic' variational principle for non-holonomic constraints, the Gibbs-Appell equations, classical path integrals, Nambu brackets and the full framing of mechanics in the language of differential geometry.

Exterior Differential Systems - Robert L. Bryant 2013-06-29

This book gives a treatment of exterior differential systems. It will in clude both the general theory and various applications. An exterior differential system is a system of equations on a manifold defined by equating to zero a number of exterior differential forms. When all the

forms are linear, it is called a pfaffian system. Our object is to study its integral manifolds, i. e. , submanifolds satisfying all the equations of the system. A fundamental fact is that every equation implies the one obtained by exterior differentiation, so that the complete set of equations associated to an exterior differential system constitutes a differential ideal in the algebra of all smooth forms. Thus the theory is coordinate-free and computations typically have an algebraic character; however, even when coordinates are used in intermediate steps, the use of exterior algebra helps to efficiently guide the computations, and as a consequence the treatment adapts well to geometrical and physical problems. A system of partial differential equations, with any number of inde pendent and dependent variables and involving partial derivatives of any order, can be written as an exterior differential system. In this case we are interested in integral manifolds on which certain coordinates remain independent. The corresponding notion in exterior differential systems is the independence condition: certain pfaffian forms remain linearly indepen dent. Partial differential equations and exterior differential systems with an independence condition are essentially the same object.

Introduction to the Calculus of Variations - Bernard Dacorogna 2004

- Serves as an excellent introduction to the calculus of variations - Useful to researchers in different fields of mathematics who want to get a concise but broad introduction to the subject - Includes more than 70 exercises with solutions

Lie Groups, Differential Equations, and Geometry - Giovanni Falcone 2017-09-19

This book collects a series of contributions addressing the various contexts in which the theory of Lie groups is applied. A preliminary chapter serves the reader both as a basic reference source and as an ongoing thread that runs through the subsequent chapters. From representation theory and Gerstenhaber algebras to control theory, from differential equations to Finsler geometry and Lepage manifolds, the book introduces young researchers in Mathematics to a wealth of different topics, encouraging a multidisciplinary approach to research. As such, it is suitable for students in doctoral courses, and will also benefit researchers who want to expand their field of interest.

Calculus of Variations and Optimal Control Theory - Daniel Liberzon 2012

This textbook offers a concise yet rigorous introduction to calculus of variations and optimal control theory, and is a self-contained resource for graduate students in engineering, applied mathematics, and related subjects. Designed specifically for a one-semester course, the book begins with calculus of variations, preparing the ground for optimal control. It then gives a complete proof of the maximum principle and covers key topics such as the Hamilton-Jacobi-Bellman theory of dynamic programming and linear-quadratic optimal control. Calculus of Variations and Optimal Control Theory also traces the historical development of the subject and features numerous exercises, notes and references at the end of each chapter, and suggestions for further study. Offers a concise yet rigorous introduction Requires limited background in control theory or advanced mathematics Provides a complete proof of the maximum principle Uses consistent notation in the exposition of classical and modern topics Traces the historical development of the subject Solutions manual (available only to teachers) Leading universities that have adopted this book include: University of Illinois at Urbana-Champaign ECE 553: Optimum Control Systems Georgia Institute of Technology ECE 6553: Optimal Control and Optimization University of Pennsylvania ESE 680: Optimal Control Theory University of Notre Dame EE 60565: Optimal Control

Constraint Theory And Quantization Methods: From Relativistic Particles To Field Theory And General Relativity - Colomo Filippo 1994-05-27

The achievement of large critical currents is critical to the applications of high-temperature superconductors. Recent developments have shown that melt processing is suitable for producing high Jc oxide superconductors. Using magnetic forces between such high Jc oxide superconductors and magnets, a person could be levitated.This book has grown largely out of research works on melt processing of high-temperature superconductors conducted at ISTEC Superconductivity

Research Laboratory. The chapters build on melt processing, microstructural characterization, fundamentals of flux pinning, critical current, and applications of bulk monolithic superconductors. The text also describes the basic mechanism of levitation and its application. This book will be useful for research workers, engineers, and graduate students in the field of superconductivity.List of Authors: H Fujimoto, S Gotoh, T Izumi; N Koshizuka, K Miya, M Murakami, N Nakamura, Y Nakamura, Y Shiohara, H Takaichi, T Taguchi, M Uesaka, H W Weber, K Yamaguchi.