

Applied Mathematical Sciences

Gregory L. Naber

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Second Edition

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Gregory L. Naber



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Topology, Geometry and Gauge fields Gregory L. Naber, 2011-03-22 A study of topology and geometry beginning with a comprehensible account of the extraordinary and rather mysterious impact of mathematical physics and especially gauge theory on the study of the geometry and topology of manifolds The focus of the book is the Yang Mills Higgs field and some considerable effort is expended to make clear its origin and significance in physics Much of the mathematics developed here to study these fields is standard but the treatment always keeps one eye on the physics and sacrifices generality in favor of clarity This second edition has replaced a brief appendix in the first on the Seiberg Witten equations with a much more detailed survey of Donaldson Witten Theory and the Witten Conjecture regarding the relationship between Donaldson and Seiberg Witten invariants A large number of exercises are included to encourage active participation on the part of the reader Review from first edition It is unusual to find a book so carefully tailored to the needs of this interdisciplinary area of mathematical physics Naber combines a knowledge of his subject with an excellent informal writing style SIAM REVIEW

Topology, Geometry, and Gauge Fields Gregory L. Naber, 2013-03-14 This volume is intended to carry on the program initiated in *Topology Geometry and Gauge Fields Foundations* henceforth N4 It is written in much the same spirit and with precisely the same philosophical motivation Mathematics and physics have gone their separate ways for nearly a century now and it is time for this to end Neither can any longer afford to ignore the problems and insights of the other Why are Dirac magnetic monopoles in one to one correspondence with the principal $U(1)$ bundles over S^2 Why do Higgs fields fall into topological types What led Donaldson in 1980 to seek in the Yang Mills equations of physics for the key that unlocks the mysteries of smooth 4 manifolds and what physical insights into quantum field theory led Witten fourteen years later to propose the vastly simpler but apparently equivalent Seiberg Witten equations as an alternative We do not presume to answer these questions here but only to promote an atmosphere in which both mathematicians and physicists recognize the need for answers More succinctly we shall endeavor to provide an exposition of elementary topology and geometry that keeps one eye on the physics in which our concepts either arose independently or have been found to lead to a deeper understanding of the phenomena Chapter 1 provides a synopsis of the geometrical background we assume of our readers manifolds Lie groups bundles connections etc

Topology, Geometry, and Gauge Fields Gregory Naber, 1997-04-24 Like any books on a subject as vast as this this book has to have a point of view to guide the selection of topics Naber takes the view that the rekindled interest that mathematics and physics have shown in each other of late should be fostered and that this is best accomplished by allowing them to cohabit The book weaves together rudimentary notions from the classical gauge theory of physics with the topological and geometrical concepts that became the mathematical models of these notions The reader is asked to join the author on some vague notion of what an electromagnetic field might be to be willing to accept a few of the more elementary pronouncements of quantum mechanics and to have a solid background in real analysis and

linear algebra and some of the vocabulary of modern algebra In return the book offers an excursion that begins with the definition of a topological space and finds its way eventually to the moduli space of anti self dual SU 2 connections on S^4 with instanton number 1

Geometric Phases in Classical and Quantum Mechanics Dariusz Chruscinski, Andrzej Jamiolkowski, 2012-12-06 Several well established geometric and topological methods are used in this work in an application to a beautiful physical phenomenon known as the geometric phase This book examines the geometric phase bringing together different physical phenomena under a unified mathematical scheme The material is presented so that graduate students and researchers in applied mathematics and physics with an understanding of classical and quantum mechanics can handle the text

The Geometry of Heisenberg Groups Ernst Binz, Sonja Pods, 2008 The three dimensional Heisenberg group being a quite simple non commutative Lie group appears prominently in various applications of mathematics The goal of this book is to present basic geometric and algebraic properties of the Heisenberg group and its relation to other important mathematical structures the skew field of quaternions symplectic structures and representations and to describe some of its applications In particular the authors address such subjects as signal analysis and processing geometric optics and quantization In each case the authors present necessary details of the applied topic being considered This book manages to encompass a large variety of topics being easily accessible in its fundamentals It can be useful to students and researchers working in mathematics and in applied mathematics

BOOK JACKET The Many Faces of Maxwell, Dirac and Einstein Equations Waldyr A. Rodrigues, Jr, Edmundo Capelas de Oliveira, 2016-04-26 This book is an exposition of the algebra and calculus of differential forms of the Clifford and Spin Clifford bundle formalisms and of vistas to a formulation of important concepts of differential geometry indispensable for an in depth understanding of space time physics The formalism discloses the hidden geometrical nature of spinor fields Maxwell Dirac and Einstein fields are shown to have representatives by objects of the same mathematical nature namely sections of an appropriate Clifford bundle This approach reveals unity in diversity and suggests relationships that are hidden in the standard formalisms and opens new paths for research This thoroughly revised second edition also adds three new chapters on the Clifford bundle approach to the Riemannian or semi Riemannian differential geometry of branes on Komar currents in the context of the General Relativity theory and an analysis of the similarities and main differences between Dirac Majorana and ELKO spinor fields The exercises with solutions the comprehensive list of mathematical symbols and the list of acronyms and abbreviations are provided for self study for students as well as for classes From the reviews of the first edition The text is written in a very readable manner and is complemented with plenty of worked out exercises which are in the style of extended examples their book could also serve as a textbook for graduate students in physics or mathematics Alberto Molgado Mathematical Reviews 2008 k

Probabilistic Models of Cosmic Backgrounds Anatoliy Malyarenko, 2024-06-30 Combining research methods from various areas of mathematics and physics Probabilistic Models of Cosmic Backgrounds describes the isotropic random sections of certain

fiber bundles and their applications to creating rigorous mathematical models of both discovered and hypothetical cosmic backgrounds Previously scattered and hard to find mathematical and physical theories have been assembled from numerous textbooks monographs and research papers and explained from different or even unexpected points of view This consists of both classical and newly discovered results necessary for understanding a sophisticated problem of modelling cosmic backgrounds The book contains a comprehensive description of mathematical and physical aspects of cosmic backgrounds with a clear focus on examples and explicit calculations Its reader will bridge the gap of misunderstanding between the specialists in various theoretical and applied areas who speak different scientific languages The audience of the book consists of scholars students and professional researchers A scholar will find basic material for starting their own research A student will use the book as supplementary material for various courses and modules A professional mathematician will find a description of several physical phenomena at the rigorous mathematical level A professional physicist will discover mathematical foundations for well known physical theories

The N-Vortex Problem Paul K. Newton, 2001-05-25 This text is an introduction to current research on the N vortex problem of fluid mechanics It describes the Hamiltonian aspects of vortex dynamics as an entry point into the rather large literature on the topic with exercises at the end of each chapter

Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields John Guckenheimer, Philip Holmes, 2013-11-21 From the reviews This book is concerned with the application of methods from dynamical systems and bifurcation theories to the study of nonlinear oscillations Chapter 1 provides a review of basic results in the theory of dynamical systems covering both ordinary differential equations and discrete mappings Chapter 2 presents 4 examples from nonlinear oscillations Chapter 3 contains a discussion of the methods of local bifurcation theory for flows and maps including center manifolds and normal forms Chapter 4 develops analytical methods of averaging and perturbation theory Close analysis of geometrically defined two dimensional maps with complicated invariant sets is discussed in chapter 5 Chapter 6 covers global homoclinic and heteroclinic bifurcations The final chapter shows how the global bifurcations reappear in degenerate local bifurcations and ends with several more models of physical problems which display these behaviors Book Review Engineering Societies Library New York 1 An attempt to make research tools concerning strange attractors developed in the last 20 years available to applied scientists and to make clear to research mathematicians the needs in applied works Emphasis on geometric and topological solutions of differential equations Applications mainly drawn from nonlinear oscillations American Mathematical Monthly 2

Elements of Applied Bifurcation Theory Yuri Kuznetsov, 1998-09-18 Providing readers with a solid basis in dynamical systems theory as well as explicit procedures for application of general mathematical results to particular problems the focus here is on efficient numerical implementations of the developed techniques The book is designed for advanced undergraduates or graduates in applied mathematics as well as for Ph D students and researchers in physics biology engineering and economics who use dynamical systems as model tools

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