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Differential Geometry of Manifolds discusses the theory of differentiable and Riemannian manifolds to help students understand the basic structures and consequent developments. Since the tangent vector plays a crucial role in the study of differentiable manifolds, this idea has been thoroughly discussed. In the theory of Riemannian geometry some new proofs have been included to enable the reader understand the subject in a comprehensive and systematic manner. This book will also benefit the postgraduate students as well as researchers working in the field of differential geometry and its applications to general relativity and cosmology. The second edition of An Introduction to Differentiable Manifolds and Riemannian Geometry, Revised has sold over 6,000 copies since publication in 1986 and this revision will make it even more useful. This is the only book available that is approachable by "beginners" in this subject. It has become an essential introduction to the subject for mathematics students, engineers, physicists, and economists who need to learn how to apply these vital methods. It is also the only book that thoroughly reviews certain areas of advanced calculus that are necessary to understand the subject. Line and surface integrals Divergence and curl of vector fields Geometry of Manifolds This book is an introduction to differential manifolds. It gives solid preliminaries for more advanced topics: Riemannian manifolds, differential topology, Lie theory. It presupposes little background: the reader is only expected to master basic differential calculus, and a little point-set topology. The book covers the main topics of differential geometry: manifolds, tangent space, vector fields, differential forms, Lie groups, and a few more sophisticated topics such as de Rham cohomology, degree theory and the Gauss-Bonnet theorem for surfaces. Its ambition is to give solid foundations. In particular, the introduction of “abstract” notions such as manifolds or differential forms is motivated via questions and examples from mathematics or theoretical physics. More than 150 exercises, some of them easy and classical, some others more sophisticated, will help the beginner as well as the more expert reader. Solutions are provided for most of them. The book should be of interest to various readers: undergraduate and graduate students for a first contact to differential manifolds, mathematicians from other fields and physicists who wish to acquire some feeling about this beautiful theory. The original French text Introduction aux variétés différentielles has been a best-seller in its category in France for many years. Jacques Lafontaine was successively assistant Professor at Paris Diderot University and Professor at the University of Montpellier, where he is presently emeritus. His main research interests are Riemannian and pseudo-Riemannian geometry, including some aspects of mathematical relativity. Besides his personal research articles, he was involved in several textbooks and research monographs. * A geometric approach to problems in physics, many of which cannot be solved by any other methods * Text is enriched with good examples and exercises at the end of every chapter * Fine for a course or seminar directed at grad and adv. undergrad students interested in elliptic and hyperbolic differential equations, differential geometry, calculus of variations, quantum mechanics, and physics This elegant book is sure to become the standard introduction to synthetic differential geometry. It deals with some classical spaces in differential geometry, namely 'prolongation spaces' or neighborhoods of the diagonal. These spaces enable a natural description of some of the basic constructions in local differential geometry and, in fact, form an inviting gateway to differential geometry, and also to some differential-geometric notions that exist in algebraic geometry. The presentation conveys the real strength of this approach to differential geometry. Concepts are clarified, proofs are streamlined, and the focus on infinitesimal spaces motivates the discussion well. Some of the specific differential-geometric theories dealt with are connection theory (notably affine connections), geometric distributions, differential forms, jet bundles, differentiable groupoids, differential operators, Riemannian metrics, and harmonic maps. Ideal for graduate students and researchers wishing to familiarize themselves with the field. The Taniguchi Symposium on global analysis on manifolds focused mainly on the relationships between some geometric structures of manifolds and analysis, especially spectral analysis on noncompact manifolds. Included in the present volume are expanded versions of most of the invited lectures. In these original research articles, the reader will find up-to date accounts of the subject. This text focuses on developing an intimate acquaintance with the geometric meaning of curvature and thereby introduces and demonstrates all the main technical tools needed for a more advanced course on Riemannian manifolds. It covers proving the four most fundamental theorems relating curvature and topology: the Gauss-Bonnet Theorem, the Cartan-Hadamard Theorem, Bonnet's Theorem, and a special case of the Cartan-Ambrose-Hicks Theorem. This carefully written book is an introduction to the beautiful ideas and results of differential geometry. The first half covers the geometry of curves and surfaces, which provide much of the motivation and intuition for the general theory. The second part studies the geometry of general manifolds, with particular emphasis on connections and curvature. The text is illustrated with many figures and examples. The prerequisites are undergraduate analysis and linear algebra. This new edition provides many advancements, including more figures and exercises, and--as a new feature--a good number of solutions to selected exercises. Book endorsed by the Sunyer Prize Committee (A. Weinstein, J. Oesterle et. al.). A famous Swiss professor gave a student's course in Basel on Riemann surfaces. After a couple of lectures, a student asked him, "Professor, you have as yet not given an exact de nition of a Riemann surface." The professor answered, "With Riemann surfaces, the main thing is to UNDERSTAND them, not to de ne them." The student's objection was reasonable. From a formal viewpoint, it is of course necessary to start as soon as possible with strict de nitions, but the professor's - swer also has a substantial background. The pure de nition of a Riemann surface— as a complex 1-dimensional complex analytic manifold—contributes little to a true understanding. It takes a long time to really be familiar with what a Riemann s- face is. This example is typical for the objects of global analysis—manifolds with str- tures. There are complex concrete de nitions but these do not automatically explain what they really are, what we can do with them, which operations they really admit, how rigid they are. Hence, there arises the natural question—how to attain a deeper understanding? One well-known way to gain an understanding is through underpinning the d- nitions, theorems and constructions with hierarchies of examples, counterexamples and exercises. Their choice, construction and logical order is for any teacher in global analysis an interesting, important and fun creating task. Basic algebraic notions -- Introduction -- A historical perspective in the algebraic context -- Algebraic preliminaries -- Jordan normal form -- Indefinite geometry -- Algebraic curvature tensors -- Hermitian and para-Hermitian geometry -- The Jacobi and skew symmetric curvature operators -- Sectional, Ricci, scalar, and Weyl curvature -- Curvature decompositions -- Self-duality and anti-self-duality conditions -- Spectral geometry of the curvature operator -- Osserman and conformally Osserman models -- Osserman curvature models in signature (2, 2) -- Ivanov-Petrova curvature models -- Osserman Ivanov-Petrova curvature models -- Commuting curvature models -- Basic geometrical notions -- Introduction -- History -- Basic manifold theory -- The tangent bundle, lie bracket, and lie groups -- The cotangent bundle and symplectic geometry -- Connections, curvature, geodesics, and holonomy -- Pseudo-Riemannian geometry -- The Levi-Civita connection -- Associated natural operators -- Weyl scalar invariants -- Null distributions -- Pseudo-Riemannian holonomy -- Other geometric structures -- Pseudo-Hermitian and para-Hermitian structures -- Hyper-para-Hermitian structures -- Geometric realizations -- Homogeneous spaces, and curvature homogeneity -- Technical results in differential equations -- Walker structures -- Introduction -- Historical development -- Walker coordinates -- Examples of Walker manifolds -- Hypersurfaces with nilpotent shape operators -- Locally conformally flat metrics with nilpotent Ricci operator -- Degenerate pseudo-Riemannian homogeneous structures -- Para-Kaehler geometry -- Twostep nilpotent lie groups with degenerate center -- Conformally symmetric pseudo-Riemannian metrics -- Riemannian extensions -- The affine category -- Twisted Riemannian extensions defined by flat connections -- Modified Riemannian extensions defined by flat connections -- Nilpotent Walker manifolds -- Osserman Riemannian extensions -- Ivanov-Petrova Riemannian extensions -- Three-dimensional Lorentzian Walker manifolds -- Introduction -- History -- Three dimensional Walker geometry -- Adapted coordinates -- The Jordan normal form of the Ricci operator -- Christoffel symbols, curvature, and the Ricci tensor -- Locally symmetric Walker manifolds -- Einstein-like manifolds -- The spectral geometry of the curvature tensor -- Curvature commutativity properties -- Local geometry of Walker manifolds with -- Foliated Walker manifolds -- Contact Walker manifolds -- Strict Walker manifolds -- Three dimensional homogeneous Lorentzian manifolds -- Three dimensional lie groups and lie algebras -- Curvature homogeneous Lorentzian manifolds -- Diagonalizable Ricci operator -- Type II Ricci operator -- Four-dimensional Walker manifolds -- Introduction -- History -- Four-dimensional Walker manifolds -- Almost para-Hermitian geometry -- Isotropic almost para-Hermitian structures -- Characteristic classes -- Self-dual Walker manifolds -- The spectral geometry of the curvature tensor -- Introduction -- History -- Four-dimensional Osserman metrics -- Osserman metrics with diagonalizable Jacobi operator -- Osserman Walker type II metrics -- Osserman and Ivanov-Petrova metrics -- Riemannian extensions of affine surfaces -- Affine surfaces with skew symmetric Ricci tensor -- Affine surfaces with symmetric and degenerate Ricci tensor -- Riemannian extensions with commuting curvature operators -- Other examples with commuting curvature operators -- Hermitian geometry -- Introduction -- History -- Almost Hermitian geometry of Walker manifolds -- The proper almost Hermitian structure of a Walker manifold -- Proper almost hyper-para-Hermitian structures -- Hermitian Walker manifolds of dimension four -- Proper Hermitian Walker structures -- Locally conformally Kaehler structures -- Almost Kaehler Walker four-dimensional manifolds -- Special Walker manifolds -- Introduction -- History -- Curvature commuting conditions -- Curvature homogeneous strict Walker manifolds -- Bibliography. From the Preface of the First Edition: ``Our purpose in writing this book is to put material which we found stimulating and interesting as graduate students into form. It is intended for individual study and for use as a text for graduate level courses such as the one from which this material stems, given by Professor W. Ambrose at MIT in 1958-1959. Previously the material had been organized in roughly the same form by him and Professor I. M. Singer, and they in turn drew upon thework of Ehresmann, Chern, and E. Cartan. Our contributions have been primarily to fill out the material with details, asides and problems, and to alter notation slightly. ``We believe that this subject matter, besides being an interesting area for specialization, lends itself especially to a synthesisof several branches of mathematics, and thus should be studied by a wide spectrum of graduate students so as to break away from narrow specialization and see how their own fields are related and applied in other fields. We feel that at least part of this subject should be of interest not only to those working in geometry, but also to those in analysis, topology, algebra, and even probability and astronomy. In order that this book be meaningful, the reader's background should include realvariable theory, linear algebra, and point set topology." This volume is a reprint with few corrections of the original work published in 1964. Starting with the notion of differential manifolds, the first six chapters lay a foundation for the study of Riemannian manifolds through specializing the theoryof connections on principle bundles and affine connections. The geometry of Riemannian manifolds is emphasized, as opposed to global analysis, so that the theorems of Hopf-Rinow, Hadamard-Cartan, and Cartan's local isometry theorem are included, but no elliptic operator theory. Isometric immersions are treated elegantly and from a global viewpoint. In the final chapter are the more complicated estimates on which much of the research in Riemannian geometry is based: the Morse index theorem,Synge's theorems on closed geodesics, Rauch's comparison theorem, and the original proof of the Bishop volume-comparison theorem (with Myer's Theorem as a corollary). The first edition of this book was the origin of a modern treatment of global Riemannian geometry, using the carefully conceived notationthat has withstood the test of time. The primary source material for the book were the papers and course notes of brilliant geometers, including E. Cartan, C. Ehresmann, I. M. Singer, and W. Ambrose. It is tightly organized, uniformly very precise, and amazingly comprehensive for its length. This book consists of two parts, different in form but similar in spirit. The first, which comprises chapters 0 through 9, is a revised and somewhat enlarged version of the 1972 book Geometrie Differentielle. The second part, chapters 10 and 11, is an attempt to remedy the notorious absence in the original book of any treatment of surfaces in three-space, an omission all the more unforgivable in that surfaces are some of the most common geometrical objects, not only in mathematics but in many branches of physics. Geometrie Differentielle was based on a course I taught in Paris in 1969- 70 and again in 1970-71. In designing this course I was decisively influ enced by a conversation with Serge Lang, and I let myself be guided by three general ideas. First, to avoid making the statement and proof of Stokes' formula the climax of the course and running out of time before any of its applications could be discussed. Second, to illustrate each new notion with non-trivial examples, as soon as possible after its introduc tion. And finally, to familiarize geometry-oriented students with analysis and analysis-oriented students with geometry, at least in what concerns manifolds. This book is based on the full year Ph.D. qualifying course on differentiable manifolds, global calculus, differential geometry, and related topics, given by the author at Washington University several times over a twenty year period. It is addressed primarily to second year graduate students and well prepared first year students. Presupposed is a good grounding in general topology and modern algebra, especially linear algebra and the analogous theory of modules over a commutative, unitary ring. Although billed as a "first course" , the book is not intended to be an overly sketchy introduction. Mastery of this material should prepare the student for advanced topics courses and seminars in differen tial topology and geometry. There are certain basic themes of which the reader should be aware. The first concerns the role of differentiation as a process of linear approximation of non linear problems. The well understood methods of linear algebra are then applied to the resulting linear problem and, where possible, the results are reinterpreted in terms of the original nonlinear problem. The process of solving differential equations (i. e., integration) is the reverse of differentiation. It reassembles an infinite array of linear approximations, result ing from differentiation, into the original nonlinear data. This is the principal tool for the reinterpretation of the linear algebra results referred to above. This volume contains the papers presented at a symposium on differential geometry at Shinshu

University in July of 1988. Carefully reviewed by a panel of experts, the papers pertain to the following areas of research: dynamical systems, geometry of submanifolds and tensor geometry, lie sphere geometry, Riemannian geometry, Yang-Mills Connections, and geometry of the Laplace operator. The subject of this book is Osserman semi-Riemannian manifolds, and in particular, the Osserman conjecture in semi-Riemannian geometry. The treatment is pitched at the intermediate graduate level and requires some intermediate knowledge of differential geometry. The notation is mostly coordinate-free and the terminology is that of modern differential geometry. Known results toward the complete proof of Riemannian Osserman conjecture are given and the Osserman conjecture in Lorentzian geometry is proved completely. Counterexamples to the Osserman conjuncture in generic semi-Riemannian signature are provided and properties of semi-Riemannian Osserman manifolds are investigated. Author has written several excellent Springer books.; This book is a sequel to Introduction to Topological Manifolds; Careful and illuminating explanations, excellent diagrams and exemplary motivation; Includes short preliminary sections before each section explaining what is ahead and why Differential Geometry of Manifolds, Second Edition presents the extension of differential geometry from curves and surfaces to manifolds in general. The book provides a broad introduction to the field of differentiable and Riemannian manifolds, tying together classical and modern formulations. It introduces manifolds in a both streamlined and mathematically rigorous way while keeping a view toward applications, particularly in physics. The author takes a practical approach, containing extensive exercises and focusing on applications, including the Hamiltonian formulations of mechanics, electromagnetism, string theory. The Second Edition of this successful textbook offers several notable points of revision. New to the Second Edition: New problems have been added and the level of challenge has been changed to the exercises Each section corresponds to a 60-minute lecture period, making it more user-friendly for lecturers Includes new sections which provide more comprehensive coverage of topics Features a new chapter on Multilinear Algebra This book is addressed to graduate students and researchers in the fields of mathematics and physics who are interested in mathematical and theoretical physics, differential geometry, mechanics, quantization theories and quantum physics, quantum groups etc., and who are familiar with differentiable and symplectic manifolds. The aim of the book is to provide the reader with a monograph that enables him to study systematically basic and advanced material on the recently developed theory of Poisson manifolds, and that also offers ready access to bibliographical references for the continuation of his study. Until now, most of this material was dispersed in research papers published in many journals and languages. The main subjects treated are the Schouten-Nijenhuis bracket; the generalized Frobenius theorem; the basics of Poisson manifolds; Poisson calculus and cohomology; quantization; Poisson morphisms and reduction; realizations of Poisson manifolds by symplectic manifolds and by symplectic groupoids and Poisson-Lie groups. The book unifies terminology and notation. It also reports on some original developments stemming from the author's work, including new results on Poisson cohomology and geometric quantization, cofoliations and biinvariant Poisson structures on Lie groups. Book endorsed by the Sunyer Prize Committee (A. Weinstein, J. Oesterle et. al.). Our first knowledge of differential geometry usually comes from the study of the curves and surfaces in I\!\!R^3 that arise in calculus. Here we learn about line and surface integrals, divergence and curl, and the various forms of Stokes' Theorem. If we are fortunate, we may encounter curvature and such things as the Serret-Frenet formulas. With just the basic tools from multivariable calculus, plus a little knowledge of linear algebra, it is possible to begin a much richer and rewarding study of differential geometry, which is what is presented in this book. It starts with an introduction to the classical differential geometry of curves and surfaces in Euclidean space, then leads to an introduction to the Riemannian geometry of more general manifolds, including a look at Einstein spaces. An important bridge from the low-dimensional theory to the general case is provided by a chapter on the intrinsic geometry of surfaces. The first half of the book, covering the geometry of curves and surfaces, would be suitable for a one-semester undergraduate course. The local and global theories of curves and surfaces are presented, including detailed discussions of surfaces of rotation, ruled surfaces, and minimal surfaces. The second half of the book, which could be used for a more advanced course, begins with an introduction to differentiable manifolds, Riemannian structures, and the curvature tensor. Two special topics are treated in detail: spaces of constant curvature and Einstein spaces. The main goal of the book is to get started in a fairly elementary way, then to guide the reader toward more sophisticated concepts and more advanced topics. There are many examples and exercises to help along the way. Numerous figures help the reader visualize key concepts and examples, especially in lower dimensions. For the second edition, a number of errors were corrected and some text and a number of figures have been added. A warped product manifold is a Riemannian or pseudo-Riemannian manifold whose metric tensor can be decomposed into a Cartesian product of the y geometry and the x geometry — except that the x-part is warped, that is, it is rescaled by a scalar function of the other coordinates y. The notion of warped product manifolds plays very important roles not only in geometry but also in mathematical physics, especially in general relativity. In fact, many basic solutions of the Einstein field equations, including the Schwarzschild solution and the Robertson–Walker models, are warped product manifolds. The first part of this volume provides a self-contained and accessible introduction to the important subject of pseudo-Riemannian manifolds and submanifolds. The second part presents a detailed and up-to-date account on important results of warped product manifolds, including several important spacetimes such as Robertson–Walker's and Schwarzschild's. The famous John Nash's embedding theorem published in 1956 implies that every warped product manifold can be realized as a warped product submanifold in a suitable Euclidean space. The study of warped product submanifolds in various important ambient spaces from an extrinsic point of view was initiated by the author around the beginning of this century. The last part of this volume contains an extensive and comprehensive survey of numerous important results on the geometry of warped product submanifolds done during this century by many geometers. Since 1961, the Georgia Topology Conference has been held every eight years to discuss the newest developments in topology. The goals of the conference are to disseminate new and important results and to encourage interaction among topologists who are in different stages of their careers. Invited speakers are encouraged to aim their talks to a broad audience, and several talks are organized to introduce graduate students to topics of current interest. Each conference results in high-quality surveys, new research, and lists of unsolved problems, some of which are then formally published. Continuing in this 40-year tradition, the AMS presents this volume of articles and problem lists from the 2001 conference. Topics covered include symplectic and contact topology, foliations and laminations, and invariants of manifolds and knots. Articles of particular interest include John Etnyre's, "Introductory Lectures on Contact Geometry", which is a beautiful expository paper that explains the background and setting for many of the other papers. This is an excellent introduction to the subject for graduate students in neighboring fields. Etnyre and Lenhard Ng's, "Problems in Low-Dimensional Contact Topology" and Danny Calegari's extensive paper,"Problems in Foliations and Laminations of 3-Manifolds" are carefully selected problems in keeping with the tradition of the conference. They were compiled by Etnyre and Ng and by Calegari with the input of many who were present. This book provides material of current interest to graduate students and research mathematicians interested in the geometry and topology of manifolds. Differential geometry began as the study of curves and surfaces using the methods of calculus. In time, the notions of curve and surface were generalized along with associated notions such as length, volume, and curvature. At the same time the topic has become closely allied with developments in topology. The basic object is a smooth manifold, to which some extra structure has been attached, such as a Riemannian metric, a symplectic form, a distinguished group of symmetries, or a connection on the tangent bundle. This book is a graduate-level introduction to the tools and structures of modern differential geometry. Included are the topics usually found in a course on differentiable manifolds, such as vector bundles, tensors, differential forms, de Rham cohomology, the Frobenius theorem and basic Lie group theory. The book also contains material on the general theory of connections on vector bundles and an in-depth chapter on semi-Riemannian geometry that covers basic material about Riemannian manifolds and Lorentz manifolds. An unusual feature of the book is the inclusion of an early chapter on the differential geometry of hyper-surfaces in Euclidean space. There is also a section that derives the exterior calculus version of Maxwell's equations. The first chapters of the book are suitable for a one-semester course on manifolds. There is more than enough material for a year-long course on manifolds and geometry. One ofthe most important features of the development of physical and mathematical sciences in the beginning of the 20th century was the demolition of prevailing views of the three-dimensional Euclidean space as the only possible mathematical description of real physical space. Apriorization of geometrical notions and identification of physical 3 space with its mathematical modellR were characteristic for these views. The discovery of non-Euclidean geometries led mathematicians to the understanding that Euclidean geometry is nothing more than one of many logically admissible geometrical systems. Relativity theory amended our understanding of the problem of space by amalgamating space and time into an integral four-dimensional manifold. One of the most important problems, lying at the crossroad of natural sciences and philosophy is the problem of the structure of the world as a whole. There are a lot of possibilities for the topology offour dimensional space-time, and at first sight a lot of possibilities arise in cosmology. In principle, not only can the global topology of the universe be complicated, but also smaller scale topological structures can be very nontrivial. One can imagine two "usual" spaces connected with a "throat", making the topology of the union complicated. This book represents a novel approach to differential topology. Its main focus is to give a comprehensive introduction to the classification of manifolds, with special attention paid to the case of surfaces, for which the book provides a complete classification from many points of view: topological, smooth, constant curvature, complex, and conformal. Each chapter briefly revisits basic results usually known to graduate students from an alternative perspective, focusing on surfaces. We provide full proofs of some remarkable results that sometimes are missed in basic courses (e.g., the construction of triangulations on surfaces, the classification of surfaces, the Gauss-Bonnet theorem, the degree-genus formula for complex plane curves, the existence of constant curvature metrics on conformal surfaces), and we give hints to questions about higher dimensional manifolds. Many examples and remarks are scattered through the book. Each chapter ends with an exhaustive collection of problems and a list of topics for further study. The book is primarily addressed to graduate students who did take standard introductory courses on algebraic topology, differential and Riemannian geometry, or algebraic geometry, but have not seen their deep interconnections, which permeate a modern approach to geometry and topology of manifolds. The author presents the extension of differential geometry from curves and surfaces to manifolds in general. It provides a broad introduction to the field of differentiable and Riemannian manifolds, tying together classical and modern formulations. The goal is to introduce manifolds in a both streamlined and mathematically rigorous way. Presents many major differential geometric acheivements in the theory of CR manifolds for the first time in book form Explains how certain results from analysis are employed in CR geometry Many examples and explicitly worked-out proofs of main geometric results in the first section of the book making it suitable as a graduate main course or seminar textbook Provides unproved statements and comments inspiring further study In recent years, increasingly complex methods have been brought into play in the treatment of geometric and topological problems for partial differential operators on manifolds. This collection of papers, resulting from a Workshop on Spectral Geometry of Manifolds with Boundary and Decomposition of Manifolds, provides a broad picture of these methods with new results. Subjects in the book cover a wide variety of topics, from recent advances in index theory and the more general theory of spectral invariants on closed manifolds and manifolds with boundary, to applications of those invariants in geometry, topology, and physics.Papers are grouped into four parts: Part I gives an overview of the subject from various points of view. Part II deals with spectral invariants, such as traces, indices, and determinants. Part III is concerned with general geometric and topological questions. Part IV deals specifically with problems on manifolds with singularities. The book is suitable for graduate students and researchers interested in spectral problems in geometry. This text focuses on developing an intimate acquaintance with the geometric meaning of curvature and thereby introduces and demonstrates all the main technical tools needed for a more advanced course on Riemannian manifolds. It covers proving the four most fundamental theorems relating curvature and topology: the Gauss-Bonnet Theorem, the Cartan-Hadamard Theorem, Bonnet’s Theorem, and a special case of the Cartan-Ambrose-Hicks Theorem. This book provides the first lucid and accessible account to the modern study of the geometry of four-manifolds. It has become required reading for postgraduates and research workers whose research touches on this topic. Pre-requisites are a firm grounding in differential topology, andgeometry as may be gained from the first year of a graduate course. The subject matter of this book is the most significant breakthrough in mathematics of the last fifty years, and Professor Donaldson won a Fields medal for his work in the area. The authors start from the standpoint that thefundamental group and intersection form of a four-manifold provides information about its homology and characteristic classes, but little of its differential topology. It turns out that the classification up to diffeomorphism of four-manifolds is very different from the classification of unimodularforms and that the study of this question leads naturally to the new Donaldson invariants of four-manifolds. A central theme of this book is that the appropriate geometrical tools for investigating these questions come from mathematical physics: the Yang-Mills theory and anti-self dual connectionsover four-manifolds. One of the many consquences of this theory is that 'exotic' smooth manifolds exist which are homeomorphic but not diffeomorphic to (4, and that large classes of forms cannot be realized as intersection forms whereas distinct manifolds may share the same form. These result havehad far-reaching consequences in algebraic geometry, topology, and mathematical physics, and will continue to be a mainspring of mathematical research for years to come. The goal of this book is to introduce the reader to some of the most frequently used techniques in modern global geometry. Suited to the beginning graduate student willing to specialize in this very challenging field, the necessary prerequisite is a good knowledge of several variables calculus, linear algebra and point-set topology.The book's guiding philosophy is, in the words of Newton, that ?in learning the sciences examples are of more use than precepts?. We support all the new concepts by examples and, whenever possible, we tried to present several facets of the same issue.While we present most of the local aspects of classical differential geometry, the book has a ?global and analytical bias?. We develop many algebraic-topological techniques in the special context of smooth manifolds such as Poincar, duality, Thom isomorphism, intersection theory, characteristic classes and the Gauss-;Bonnet theorem.We devoted quite a substantial part of the book to describing the analytic techniques which have played an increasingly important role during the past decades. Thus, the last part of the book discusses elliptic equations, including elliptic Lpand H”lder estimates, Fredholm theory, spectral theory, Hodge theory, and applications of these. The last chapter is an in-depth investigation of a very special, but fundamental class of elliptic operators, namely, the Dirac type operators.The second edition has many new examples and exercises, and an entirely new chapter on classical integral geometry where we describe some mathematical gems which, undeservedly, seem to have disappeared from the contemporary mathematical limelight. Manifolds, the higher-dimensional analogs of smooth curves and surfaces, are fundamental objects in modern mathematics. Combining aspects of algebra, topology, and analysis, manifolds have also been applied to classical mechanics, general relativity, and quantum field theory. In this streamlined introduction to the subject, the theory of manifolds is presented with the aim of helping the reader achieve a rapid mastery of the essential topics. By the end of the book the reader should be able to compute, at least for simple spaces, one of the most basic topological invariants of a manifold, its de Rham cohomology. Along the way, the reader acquires the knowledge and skills necessary for further study of geometry and topology. The requisite point-set topology is included in an appendix of twenty pages; other appendices review facts from real analysis and linear algebra. Hints and solutions are provided to many of the exercises and problems. This work may be used as the text for a one-semester graduate or advanced undergraduate course, as well as by students engaged in self-study. Requiring only minimal undergraduate prerequisites, 'Introduction to Manifolds' is also an excellent foundation for Springer's GTM 82, 'Differential Forms in Algebraic Topology'. Curves and surfaces are objects that everyone can see, and many of the questions that can be asked about them are natural and easily understood. Differential geometry is concerned with the precise mathematical formulation of some of these questions, while trying to answer them using calculus techniques. The geometry of differentiable manifolds with structures is one of the most important branches of modern differential geometry. This well-written book discusses the theory of differential and Riemannian manifolds to help students understand the basic structures and consequent developments. While introducing concepts such as bundles, exterior algebra and calculus, Lie group and its algebra and calculus, Riemannian geometry, submanifolds and hypersurfaces, almost complex manifolds, etc., enough care has been taken to provide necessary details which enable the reader to grasp them easily. The material of this book has been successfully tried in classroom teaching. The book is designed for the postgraduate students of Mathematics. It will also be useful to the researchers working in the field of differential geometry and its applications to general theory of relativity and cosmology, and other applied areas. KEY FEATURES ? Provides basic concepts in an easy-to-understand style. ? Presents the subject in a natural way. ? Follows a coordinate-free approach. ? Includes a large number of solved examples and illuminating illustrations. ? Gives notes and remarks at appropriate places.