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Tensors and Riemannian Geometry - Nail H. Ibragimov 2015-08-31
This book is based on the experience of teaching the subject by the author in Russia, France, South Africa and Sweden. The author provides students and teachers with an easy to follow textbook spanning a variety of topics on tensors, Riemannian geometry and geometric approach to partial differential equations. Application of approximate transformation groups to the equations of general relativity in the de Sitter space simplifies the subject significantly.

Differential Geometry of Curves and Surfaces - Thomas F. Banchoff 2010-03-01
Students and professors of an undergraduate course in differential geometry will appreciate the clear exposition and comprehensive exercises in this book that focuses on the geometric properties of curves and surfaces, one- and two-dimensional objects in Euclidean space. The problems generally relate to questions of local properties (the properties

Elementary Topics in Differential Geometry - J. A. Thorpe 2012-12-06
In the past decade there has been a significant change in the freshman/ sophomore mathematics curriculum as taught at many, if not most, of our colleges. This has been brought about by the introduction of linear algebra into the curriculum at the sophomore level. The advantages of using linear algebra both in the teaching of differential equations and in the teaching of multivariate calculus are by now widely recognized. Several textbooks adopting this point of view are now available and have been widely adopted. Students completing the sophomore year now have a fair preliminary under standing of spaces of many dimensions. It should be apparent that courses on the junior level should draw upon and reinforce the concepts and skills learned during the previous year. Unfortunately, in differential geometry at least, this is usually not the case. Textbooks directed to students at this level generally restrict attention to 2-dimensional surfaces in 3-space rather than to surfaces of arbitrary dimension. Although most of the recent books do use linear algebra, it is only the algebra of ~3. The student's preliminary understanding of higher dimensions is not cultivated.

Curves and Surfaces - Pierre-Jean Laurent 2014-05-12
Curves and Surfaces provides information pertinent to the fundamental aspects of approximation theory with emphasis on approximation of images, surface compression, wavelets, and tomography. This book covers a variety of topics, including error estimates for multiquadratic interpolation, spline manifolds, and vector spline approximation. Organized into 77 chapters, this book begins with an overview of the method, based on a local Taylor expansion of the final curve, for computing the parameter values. This text then presents a vector approximation based on general spline function theory. Other chapters consider a nonparametric technique for estimating under random censorship the amplitude of a change point in change point hazard models. This book discusses as well the algorithm for ray tracing rational parametric surfaces based on inversion and implicitization. The final chapter deals with the results concerning the norm of the interpolation operator and error estimates for a square domain. This book is a valuable resource for mathematicians.

Shape Interrogation for Computer Aided Design and Manufacturing - Nicholas M. Patrikalakis 2009-11-27
Shape interrogation is the process of extraction of information from a geometric model. It is a fundamental component of Computer Aided Design and Manufacturing (CAD/CAM) systems. This book provides a bridge between the areas geometric modeling and solid modeling. Apart from the differential geometry topics covered, the entire book is based on the unifying concept of recasting all shape interrogation problems to the solution of a nonlinear system. It provides the mathematical fundamentals as well as algorithms for various shape interrogation methods including nonlinear polynomial solvers, intersection problems, differential geometry of intersection curves, distance functions, curve and surface interrogation, umbilics and lines of curvature, and geodesics.

Topology from the Differentiable Viewpoint - John Milnor 1997-12-14
This elegant book by distinguished mathematician John Milnor, provides a clear and succinct introduction to one of the most important subjects in modern mathematics. Beginning with basic concepts such as diffeomorphisms and smooth manifolds, he goes on to examine tangent spaces, oriented manifolds, and vector fields. Key concepts such as homotopy, the index number of a map, and the Pontryagin construction are discussed. The author presents proofs of Sard's theorem and the Hopf theorem.

Curves and Surfaces - M. Abate 2012-06-11
The book provides an introduction to Differential Geometry of Curves and Surfaces. The theory of curves starts with a discussion of possible definitions of the concept of curve, proving in particular the classification of 1-dimensional manifolds. We then present the classical local theory of parametrized plane and space curves (curves in n-dimensional space are discussed in the complementary material): curvature, torsion, Frenet's formulas and the fundamental theorem of the local theory of curves. Then, after a self-contained presentation of degree theory for continuous self-maps of the circumference, we study the global theory of plane curves, introducing winding and rotation numbers, and proving the Jordan curve theorem for curves of class C2, and Hopf theorem on the rotation number of closed simple curves. The local theory of surfaces begins with a comparison of the concept of parametrized (i.e., immersed) surface with the concept of regular (i.e., embedded) surface. We then develop the basic differential geometry of surfaces in R3: definitions, examples, differentiable maps and functions, tangent vectors (presented both as vectors tangent to curves in the surface and as derivations on germs of differentiable functions; we shall consistently use both approaches in the whole book) and orientation. Next we study the several notions of curvature on a surface, stressing both the geometrical meaning of the objects introduced and the algebraic/analytical methods needed to study them via the Gauss map, up to the proof of Gauss' Teorema Egregium. Then we introduce vector fields on a surface (flow, first integrals, integral curves) and geodesics (definition, basic properties, geodesic curvature, and, in the complementary material, a full proof of minimizing properties of geodesics and of the Hopf-Rinow theorem for surfaces). Then we shall present a proof of the celebrated Gauss-Bonnet theorem, both in its local and in its global form, using basic properties (fully proved in the complementary material) of triangulations of surfaces. As an application, we shall prove the Poincaré-Hopf theorem on zeroes of vector fields. Finally, the last chapter will be devoted to several important results on the global theory of surfaces, like for instance the characterization of surfaces with constant Gaussian curvature, and the orientability of compact surfaces in R3.

Exam Prep for Differential Geometry of Curves and Surfaces by Docarmo, 1st Ed. - Docarmo 2009-08-01
The MznLnx Exam Prep series is designed to help you pass your exams. Editors at MznLnx review your textbooks and then prepare these practice exams to help you master the textbook material. Unlike study guides, workbooks, and practice tests provided by the texbook publisher and textbook authors, MznLnx gives you all of the material in each chapter in exam form, not just samples, so you can be sure to nail your exam.

An Introduction to Differential Geometry - T. J. Willmore 2013-05-13
This text employs vector methods to explore the classical theory of curves and surfaces. Topics include basic theory of tensor algebra, tensor calculus, calculus of differential forms, and elements of Riemannian geometry. 1959 edition.

Lectures on Differential Geometry - Iskander Asanovich Taĭmanov 2008
This book gives an introduction to the basics of differential geometry, keeping in mind the natural origin of many geometrical quantities, as well as the applications of differential geometry and its methods to other sciences. The book is based on lectures the author held repeatedly at Novosibirsk State University. It is addressed to students as well as to anyone who wants to learn the basics of differential geometry.

Cram101 Textbook Outlines to Accompany - Manfredo Perdigão do Carmo 2007

Elementary Differential Geometry - A.N. Pressley 2013-11-11
Pressley assumes the reader knows the main results of multivariate calculus and concentrates on the theory of the study of surfaces. Used for courses on surface geometry, it includes intersting and in-depth examples and goes into the subject in great detail and vigour. The book will cover three-dimensional Euclidean space only, and takes the whole book to cover the material and treat it as a subject in its own right.

Manifolds and Differential Geometry - Jeffrey Marc Lee 2009
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.

Lectures on Classical Differential Geometry - Dirk Jan Struik 1961-01-01
Elementary, yet authoritative and scholarly, this book offers an excellent brief introduction to the classical theory of differential geometry. It is aimed at advanced undergraduate and graduate students who will find it not only highly readable but replete with illustrations carefully selected to help stimulate the student's visual understanding of geometry. The text features an abundance of problems, most of which are simple enough for class use, and often convey an interesting geometrical fact. A selection of more difficult problems has been included to challenge the ambitious student. Written by a noted mathematician and historian of mathematics, this volume presents the fundamental conceptions of the theory of curves and surfaces and applies them to a number of examples. Dr. Struik has enhanced the treatment with copious historical, biographical, and bibliographical references that place the theory in context and encourage the student to consult original sources and discover additional important ideas there. For this second edition, Professor Struik made some corrections and added an appendix with a sketch of the application of Cartan's method of Pfaffians to curve and surface theory. The result was to further increase the merit of this stimulating, thought-provoking text — ideal for classroom use, but also perfectly suited for self-study. In this attractive, inexpensive paperback edition, it belongs in the library of any mathematician or student of mathematics interested in differential geometry.

Riemannian Manifolds - John M. Lee 2006-04-06
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.

Differential Geometry: Manifolds, Curves, and Surfaces - Marcel Berger 2012-12-06
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.

Differential Geometry of Curves and Surfaces - Victor Andreevich Toponogov 2006-09-10
Central topics covered include curves, surfaces, geodesics, intrinsic geometry, and the Alexandrov global angle comparision theorem Many nontrivial and original problems (some with hints and solutions) Standard theoretical material is combined with more difficult theorems and complex problems, while maintaining a clear distinction between the two levels

Differential Geometry in Array Processing -

Riemannian Geometry - Manfredo Perdigão do Carmo 1992

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Elementary Differential Geometry - Barrett O'Neill 2014-05-12
Elementary Differential Geometry focuses on the elementary account of the geometry of curves and surfaces. The book first offers information on calculus on Euclidean space and frame fields. Topics include structural equations, connection forms, frame fields, covariant derivatives, Frenet formulas, curves, mappings, tangent vectors, and differential forms. The publication then examines Euclidean geometry and calculus on a surface. Discussions focus on topological properties of surfaces, differential forms on a surface, integration of forms, differentiable functions and tangent vectors, congruence of curves, derivative map of an isometry, and Euclidean geometry. The manuscript takes a look at shape operators, geometry of surfaces in E, and Riemannian geometry. Concerns include geometric surfaces, covariant derivative, curvature and conjugate points, Gauss-Bonnet theorem, fundamental equations, global theorems, isometries and local isometries, orthogonal coordinates, and integration and orientation. The text is a valuable reference for students interested in elementary differential geometry.

Elements of Differential Geometry - Richard S. Millman 1977
This text is intended for an advanced undergraduate (having taken linear algebra and multivariable calculus). It provides the necessary background for a more abstract course in differential geometry. The inclusion of diagrams is done without sacrificing the rigor of the material. For all readers interested in differential geometry.

Differential Forms and Applications - Manfredo P. Do Carmo 1998-05-20
An application of differential forms for the study of some local and global aspects of the differential geometry of surfaces. Differential forms are introduced in a simple way that will make them attractive to "users" of mathematics. A brief and elementary introduction to differentiable manifolds is given so that the main theorem, namely Stokes' theorem, can be presented in its natural setting. The applications consist in developing the method of moving frames expounded by E. Cartan to study the local differential geometry of immersed surfaces in R3 as well as the intrinsic geometry of surfaces. This is then collated in the last chapter to present Chern's proof of the Gauss-Bonnet theorem for compact surfaces.

Differential Geometry, Lie Groups, and Symmetric Spaces - Sigurdur Helgason 2001-06-12
A great book ... a necessary item in any mathematical library. --S. S. Chern, University of California A brilliant book: rigorous, tightly organized, and covering a vast amount of good mathematics. --Barrett O'Neill, University of California This is obviously a very valuable and well

thought-out book on an important subject. --Andre Weil, Institute for Advanced Study The study of homogeneous spaces provides excellent insights into both differential geometry and Lie groups. In geometry, for instance, general theorems and properties will also hold for homogeneous spaces, and will usually be easier to understand and to prove in this setting. For Lie groups, a significant amount of analysis either begins with or reduces to analysis on homogeneous spaces, frequently on symmetric spaces. For many years and for many mathematicians, Sigurdur Helgason's classic Differential Geometry, Lie Groups, and Symmetric Spaces has been--and continues to be--the standard source for this material. Helgason begins with a concise, self-contained introduction to differential geometry. Next is a careful treatment of the foundations of the theory of Lie groups, presented in a manner that since 1962 has served as a model to a number of subsequent authors. This sets the stage for the introduction and study of symmetric spaces, which form the central part of the book. The text concludes with the classification of symmetric spaces by means of the Killing-Cartan classification of simple Lie algebras over $\mathbb{C}$ and Cartan's classification of simple Lie algebras over $\mathbb{R}$, following a method of Victor Kac. The excellent exposition is supplemented by extensive collections of useful exercises at the end of each chapter. All of the problems have either solutions or substantial hints, found at the back of the book. For this edition, the author has made corrections and added helpful notes and useful references. Sigurdur Helgason was awarded the Steele Prize for Differential Geometry, Lie Groups, and Symmetric Spaces and Groups and Geometric Analysis.

Differential Geometry of Curves and Surfaces - Kristopher Tapp 2016-09-30

This is a textbook on differential geometry well-suited to a variety of courses on this topic. For readers seeking an elementary text, the prerequisites are minimal and include plenty of examples and intermediate steps within proofs, while providing an invitation to more excursive applications and advanced topics. For readers bound for graduate school in math or physics, this is a clear, concise, rigorous development of the topic including the deep global theorems. For the benefit of all readers, the author employs various techniques to render the difficult abstract ideas herein more understandable and engaging. Over 300 color illustrations bring the mathematics to life, instantly clarifying concepts in ways that grayscale could not. Green-boxed definitions and purple-boxed theorems help to visually organize the mathematical content. Color is even used within the text to highlight logical relationships. Applications abound! The study of conformal and equiareal functions is grounded in its application to cartography. Evolutes, involutes and cycloids are introduced through Christiaan Huygens' fascinating story: in attempting to solve the famous longitude problem with a mathematically-improved pendulum clock, he invented mathematics that would later be applied to optics and gears. Clairaut's Theorem is presented as a conservation law for angular momentum. Green's Theorem makes possible a drafting tool called a planimeter. Foucault's Pendulum helps one visualize a parallel vector field along a latitude of the earth. Even better, a south-pointing chariot helps one visualize a parallel vector field along any curve in any surface. In truth, the most profound application of differential geometry is to modern physics, which is beyond the scope of this book. The GPS in any car wouldn't work without general relativity, formalized through the language of differential geometry. Throughout this book, applications, metaphors and visualizations are tools that motivate and clarify the rigorous mathematical content, but never replace it.

Differential Geometry of Curves and Surfaces - Manfredo P. do Carmo 2016-12-14

One of the most widely used texts in its field, this volume introduces the differential geometry of curves and surfaces in both local and global aspects. The presentation departs from the traditional approach with its more extensive use of elementary linear algebra and its emphasis on basic geometrical facts rather than machinery or random details. Many examples and exercises enhance the clear, well-written exposition, along with hints and answers to some of the problems. The treatment begins with a chapter on curves, followed by explorations of regular surfaces, the geometry of the Gauss map, the intrinsic geometry of surfaces, and global differential geometry. Suitable for advanced undergraduates and graduate students of mathematics, this text's prerequisites include an undergraduate course in linear algebra and some familiarity with the calculus of several variables. For this second edition, the author has corrected, revised, and updated the entire volume.

A First Course in Differential Geometry - Lyndon Woodward 2019

With detailed explanations and numerous examples, this textbook covers the differential geometry of surfaces in Euclidean space.

Differential Geometry - Loring W. Tu 2017-06-01

This text presents a graduate-level introduction to differential geometry for mathematics and physics students. The exposition follows the historical development of the concepts of connection and curvature with the goal of explaining the Chern–Weil theory of characteristic classes on a principal bundle. Along the way we encounter some of the high points in the history of differential geometry, for example, Gauss' Theorema Egregium and the Gauss–Bonnet theorem. Exercises throughout the book test the reader's understanding of the material and sometimes illustrate extensions of the theory. Initially, the prerequisites for the reader include a passing familiarity with manifolds. After the first chapter, it becomes necessary to understand and manipulate differential forms. A knowledge of de Rham cohomology is required for the last third of the text. Prerequisite material is contained in author's text An Introduction to Manifolds, and can be learned in one semester. For the benefit of the reader and to establish common notations, Appendix A recalls the basics of manifold theory. Additionally, in an attempt to make the exposition more self-contained, sections on algebraic constructions such as the tensor product and the exterior power are included. Differential geometry, as its name implies, is the study of geometry using differential calculus. It dates back to Newton and Leibniz in the seventeenth century, but it was not until the nineteenth century, with the work of Gauss on surfaces and Riemann on the curvature tensor, that differential geometry flourished and its modern foundation was laid. Over the past one hundred years, differential geometry has proven indispensable to an understanding of the physical world, in Einstein's general theory of relativity, in the theory of gravitation, in gauge theory, and now in string theory. Differential geometry is also useful in topology, several complex variables, algebraic geometry, complex manifolds, and dynamical systems, among other fields. The field has even found applications to group theory as in Gromov's work and to probability theory as in Diaconis's work. It is not too far-fetched to argue that differential geometry should be in every mathematician's arsenal.

Curves and Surfaces - Sebastián Montiel 2009

This introductory textbook puts forth a clear and focused point of view on the differential geometry of curves and surfaces. Following the modern point of view on differential geometry, the book emphasizes the global aspects of the subject. The excellent collection of examples and exercises (with hints) will help students in learning the material. Advanced undergraduates and graduate students will find this a nice entry point to differential geometry. In order to study the global properties of curves and surfaces, it is necessary to have more sophisticated tools than are usually found in textbooks on the topic. In particular, students must have a firm grasp on certain topological theories. Indeed, this monograph treats the Gauss-Bonnet theorem and discusses the Euler characteristic. The authors also cover Alexandrov's theorem on embedded compact surfaces in $\mathbb{R}^3$ with constant mean curvature. The last chapter addresses the global geometry of curves, including periodic space curves and the four-vertices theorem for plane curves that are not necessarily convex. Besides being an introduction to the lively subject of curves and surfaces, this book can also be used as an entry to a wider study of differential geometry. It is suitable as the text for a first-year graduate course or an advanced undergraduate course.

Elementary Differential Geometry - Christian Bär 2010-05-06

This easy-to-read introduction takes the reader from elementary problems through to current research. Ideal for courses and self-study.

Differential Geometry - Heinrich W. Guggenheimer 2012-04-27

This text contains an elementary introduction to continuous groups and differential invariants; an extensive treatment of groups of motions in euclidean, affine, and riemannian geometry; more. Includes exercises and 62 figures.

Differential Geometry of Curves and Surfaces - Manfredo Perdigão do Carmo 1976

This volume covers local as well as global differential geometry of curves and surfaces.

Elementary Differential Geometry - A.N. Pressley 2010-03-10

Elementary Differential Geometry presents the main results in the differential geometry of curves and surfaces suitable for a first course on the subject. Prerequisites are kept to an absolute minimum – nothing beyond first courses in linear algebra and multivariable calculus – and the most direct and straightforward approach is used throughout. New features of this revised and expanded second edition include: a chapter on non-Euclidean geometry, a subject that is of great importance in the history of mathematics and crucial in many modern developments. The main results can be reached easily and quickly by making use of the results and techniques developed earlier in the book. Coverage of topics such as: parallel transport and its applications; map colouring; holonomy and Gaussian curvature. Around 200 additional exercises, and a full solutions manual for instructors, available via www.springer.com ul

An Introduction to Manifolds - Loring W. Tu 2010-10-05

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'.

Differential Geometry and Statistics - M.K. Murray 2017-10-19

Several years ago our statistical friends and relations introduced us to the work of Amari and Barndorff-Nielsen on applications of differential geometry to statistics. This book has arisen because we believe that there is a deep relationship between statistics and differential geometry and moreoever that this relationship uses parts of differential geometry, particularly its 'higher-order' aspects not readily accessible to a statistical audience from the existing literature. It is, in part, a long reply to the frequent requests we have had for references on differential geometry! While we have not gone beyond the path-breaking work of Amari and Barndorff- Nielsen in the realm of applications, our book gives some new explanations of their ideas from a first principles point of view as far as geometry is concerned. In particular it seeks to explain why geometry should enter into parametric statistics, and how the theory of asymptotic expansions involves a form of higher-order differential geometry. The first chapter of the book explores exponential families as flat geometries. Indeed the whole notion of using log-likelihoods amounts to exploiting a particular form of flat space known as an affine geometry, in which straight lines and planes make sense, but lengths and angles are absent. We use these geometric ideas to introduce the notion of the second fundamental form of a family whose vanishing characterises precisely the exponential families.

Functional Differential Geometry - Gerald Jay Sussman 2013-07-05

An explanation of the mathematics needed as a foundation for a deep understanding of general relativity or quantum field theory. Physics is naturally expressed in mathematical language. Students new to the subject must simultaneously learn an idiomatic mathematical language and the content that is expressed in that language. It is as if they were asked to read Les Misérables while struggling with French grammar. This book offers an innovative way to learn the differential geometry needed as a foundation for a deep understanding of general relativity or quantum field theory as taught at the college level. The approach taken by the authors (and used in their classes at MIT for many years) differs from the conventional one in several ways, including an emphasis on the development of the covariant derivative and an avoidance of the use of traditional index notation for tensors in favor of a semantically richer language of vector fields and differential forms. But the biggest single difference is the authors' integration of computer programming into their explanations. By programming a computer to interpret a formula, the student soon learns whether or not a formula is correct. Students are led to improve their program, and as a result improve their understanding.

Differential Geometry - Wolfgang Kühnel 2006

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.

Differential Geometry of Curves and Surfaces - Shoshichi Kobayashi 2019-11-13

This book is a posthumous publication of a classic by Prof. Shoshichi Kobayashi, who taught at U.C. Berkeley for 50 years, recently translated by Eriko Shinozaki Nagumo and Makiko Sumi Tanaka. There are five chapters: 1. Plane Curves and Space Curves; 2. Local Theory of Surfaces in Space; 3. Geometry of Surfaces; 4. Gauss–Bonnet Theorem; and 5. Minimal Surfaces. Chapter 1 discusses local and global properties of planar curves and curves in space. Chapter 2 deals with local properties of surfaces in 3-dimensional Euclidean space. Two types of curvatures — the Gaussian curvature K and the mean curvature H —are introduced. The method of the moving frames, a standard technique in differential geometry, is introduced in the context of a surface in 3-dimensional Euclidean space. In Chapter 3, the Riemannian metric on a surface is introduced and properties determined only by the first fundamental form are discussed. The concept of a geodesic introduced in Chapter 2 is extensively discussed, and several examples of geodesics are presented with illustrations. Chapter 4 starts with a simple and elegant proof of Stokes' theorem for a domain. Then the Gauss–Bonnet theorem, the major topic of this book, is discussed at great length. The theorem is a most beautiful and deep result in differential geometry. It yields a relation between the integral of the Gaussian curvature over a given oriented closed surface S and the topology of S in terms of its Euler number χ(S). Here again, many illustrations are provided to facilitate the reader's understanding. Chapter 5, Minimal Surfaces, requires some elementary knowledge of complex analysis. However, the author retained the introductory nature of this book and focused on detailed explanations of the examples of minimal surfaces given in Chapter 2.

Multivariable Calculus and Differential Geometry - Gerard Walschap 2015-07-01

This book offers an introduction to differential geometry for the non-specialist. It includes most of the required material from multivariable calculus, linear algebra, and basic analysis. An intuitive approach and a minimum of prerequisites make it a valuable companion for students of mathematics and physics. The main focus is on manifolds in Euclidean space and the metric properties they inherit from it. Among the topics discussed are curvature and how it affects the shape of space, and the generalization of the fundamental theorem of calculus known as Stokes' theorem.

Differential Geometry and Its Applications - John Oprea 2007-09-06

Differential geometry has a long, wonderful history it has found relevance in areas ranging from machinery design of the classification of four-manifolds to the creation of theories of nature's fundamental forces to the study of DNA. This book studies the differential geometry of surfaces with the goal of helping students make the transition from the compartmentalized courses in a standard university curriculum to a type of mathematics that is a unified whole, it mixes geometry, calculus, linear algebra, differential equations, complex variables, the calculus of variations, and notions from the sciences. Differential geometry is not just for mathematics majors, it is also for students in engineering and the sciences. Into the mix of these ideas comes the opportunity to visualize concepts through the use of computer algebra systems such as Maple. The book emphasizes that this visualization goes hand-in-hand with the understanding of the mathematics behind the computer construction. Students will not only “see” geodesics on surfaces, but they will also see the effect that an abstract result such as the Clairaut relation can have on geodesics. Furthermore, the book shows how the equations of motion of particles constrained to surfaces are actually types of geodesics. Students will also see how particles move under constraints. The book is rich in results and exercises that form a continuous spectrum, from those that depend on calculation to proofs that are quite abstract.

