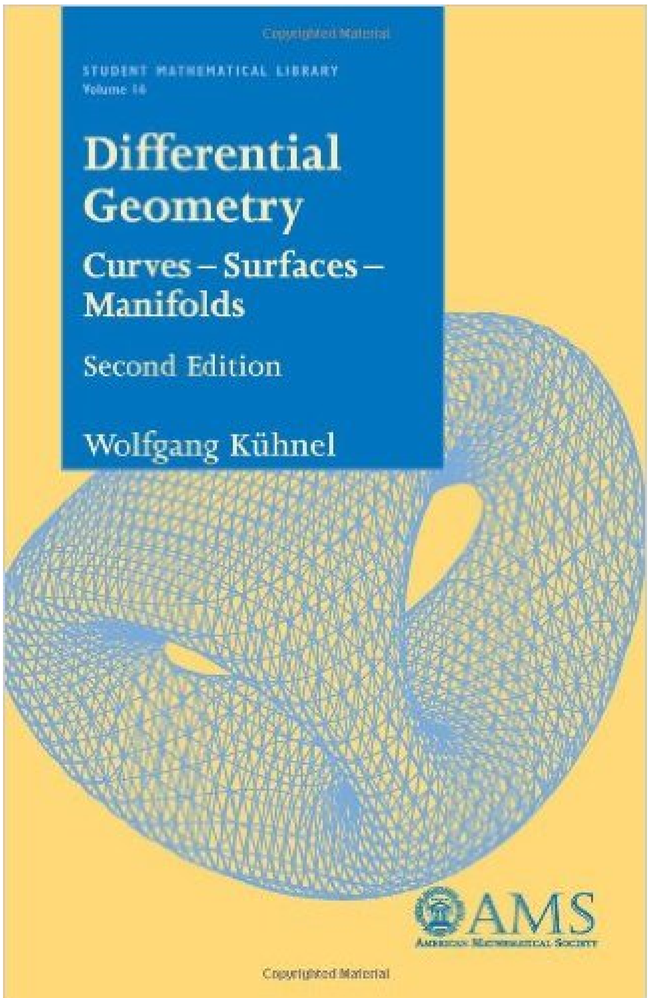
Differential Geometry: Curves - Surfaces - Manifolds, Second Edition



Synopsis

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.

Book Information

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Customer Reviews

This is a very fast moving book, covering a huge amount of material at a fairly sophisticated level in under 380 pages. For example, differential forms are introduced in about 2 pages so that the Maurer-Cartan structural equations can be defined. The first 4 chapters makes up a very concise course in curves and surfaces, while the last 4 chapters cover Riemannian geometry. In comparison, do Carmo’s two books take 500 pages for the former and 320 pages for the latter.For this reason I think the claim that this could be used as an undergraduate text is overly optimistic. For that I would use a more self-contained text like Millman & Parker (ISBN: 0132641437). But it would make an excellent text for a graduate survey, or as a second text for someone wanting to make the transition from classical theory (learned from, say, one of the Dover books like Struik, ISBN: 0486656098) to more modern methods. Also, you’ll probably want to supplement with a gentler introduction to differential forms.Of interest to students of physics, the book covers curves and surfaces in Minkowski space, as well as Einstein spaces.

While there is exist many classic texts on differential geometry, I have particularly appreciated this book for its up-to-date treatment, numerous well-done figures, broad coverage, elegant type-setting, and clear expositions. The book covers all the basics expected from an introduction to differential geometry, including curves and 2-D surfaces, but with a look towards the more advanced material in the second half of the book. It alternates between Ricci style notation and Koszul style notation, often carefully explaining the relation between the two and giving examples (I found this particularly helpful). There are, however, some sections where the english is a bit rough (perhaps the fault of the translator). It is also quite brisk throughout, often mentioning advanced topics before they are treated in detail. For example, it already mentions submanifolds, tangent spaces, and tangent bundles in the first chapter on "Notations and Prerequisites from Analysis." It will require serious attention, especially if one has not encountered a good dose of abstract mathematics before. Nonetheless, I have found myself returning to it over several years as an excellent reference and source of many additional topics that I skipped on a first reading. For example, the final chapter on Einstein spaces is a valuable, though demanding, bonus. Thanks to the AMS for publishing a fine edition of a top-notch German author’s work.

I feel, the book is an excellent introduction to differential geometry. It moves on gradually, from curves to Einstein manifolds. Much emphasis is placed on visualizing the concepts. While mostly using the 'coordinate free' approach, all important statements are also given in the 'Ricci calculus' version.The mathematical prerequisits are modest, I feel, an undergratuate background is more than sufficient. (I am only a hobby mathematician, and my background was adequate).Virtually all statements are proven, and the proofs are not too difficult to follow - without any sacrifice in rigor.Nice for self study: the book is almost typo free. I found less than 20, almost all of them harmless.