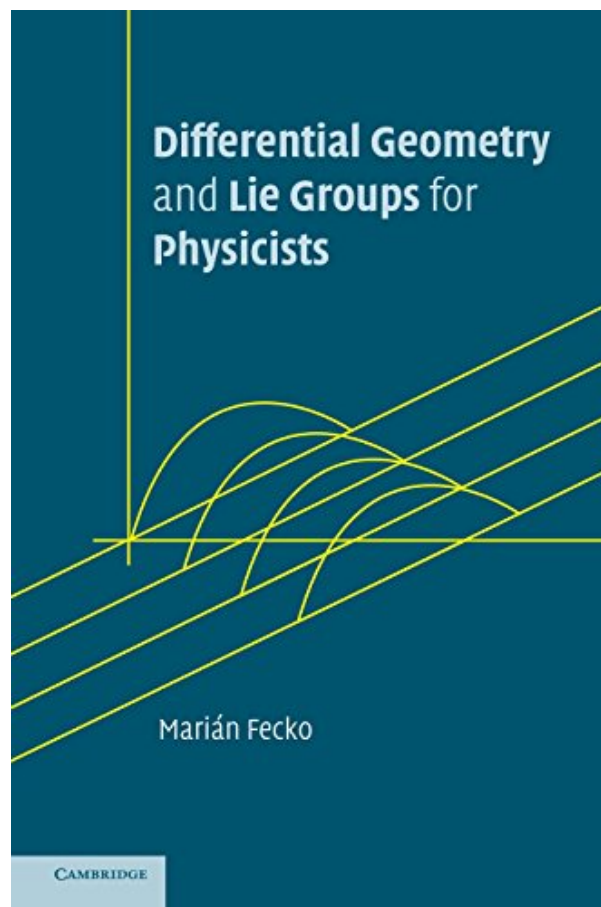
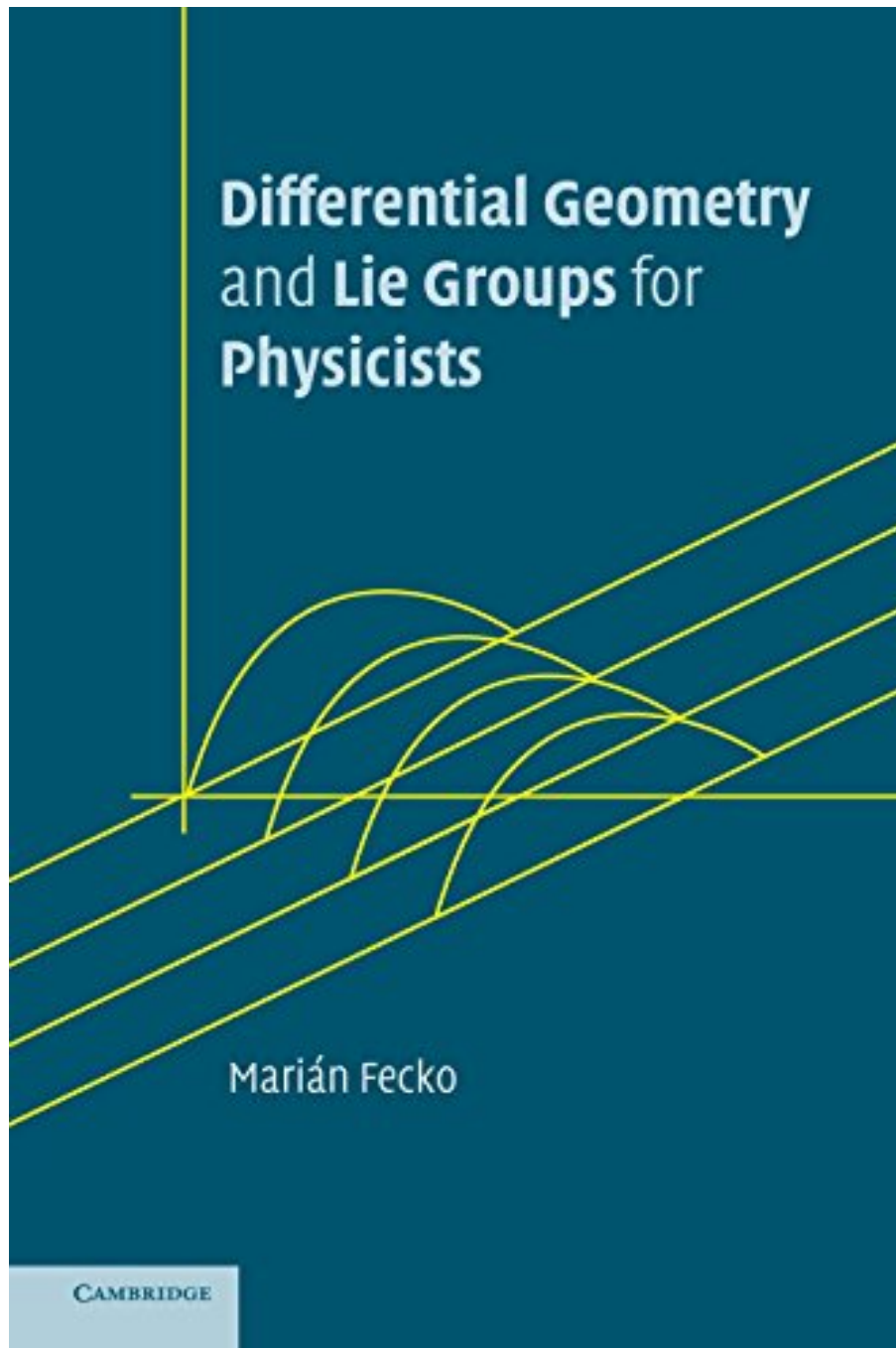


DIFFERENTIAL GEOMETRY AND LIE GROUPS FOR PHYSICISTS BY MARIÁN FECKO



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Review

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Hans-Peter Künzle, Mathematical Reviews

"All basic material that is necessary for a young scientist in the field of geometrical formulation of physical theories is included ... ordered and represented in a very appropriate manner ... with a great respect to the reader. ... I truly believe that reading this book will bring a real pleasure to all physically inclined young mathematicians and mathematically inclined young physicists ... a very good high level textbook ... [I] recommend it to all young scientists being interested in finding correspondence between harmony in the physical world and harmony in geometrical structures. ... well written, very well ordered and the exposition is very clear."

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American Mathematical Society

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impression of a caring, experienced (and often quirkily funny, but never boring) tutor who really, really wants you to succeed."

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Differential geometry plays an increasingly important role in modern theoretical physics and applied mathematics. This textbook gives an introduction to geometrical topics useful in theoretical physics and applied mathematics, covering: manifolds, tensor fields, differential forms, connections, symplectic geometry, actions of Lie groups, bundles, spinors, and so on. Written in an informal style, the author places a strong emphasis on developing the understanding of the general theory through more than 1000 simple exercises, with complete solutions or detailed hints. The book will prepare readers for studying modern treatments of Lagrangian and Hamiltonian mechanics, electromagnetism, gauge fields, relativity and gravitation. Differential Geometry and Lie Groups for Physicists is well suited for courses in physics, mathematics and engineering for advanced undergraduate or graduate students, and can also be used for active self-study. The required mathematical background knowledge does not go beyond the level of standard introductory undergraduate mathematics courses.

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Sergei Slobodov, UBC for Physics in Canada

Most helpful customer reviews

6 of 8 people found the following review helpful.

Differential geometry

By Michal Tarana

Marian Fecko's textbook covers well fundamental elements of modern differential geometry and introduction to the Lie groups (not only) from geometrical point of view. Geometrical formulations of the classical mechanics, gauge theory and classical electrodynamics are discussed.

The textbook expects the reader to be familiar with mathematical analysis on the level of the standard course usual in the physics undergraduate study programs. Understanding of the parts dealing with physical applications (classical mechanics and electrodynamics) expects knowledge of fundamental principles of these subjects. Organization of the book allows the reader to concern on particular part, i. e. understanding of later parts doesn't require reading of all previous parts (reading of parts concerning on the classical dynamics does not require reading of parts dealing with electrodynamics). However, relations between different subjects of the theory are explained instructively.

The main advantage of this textbook is that reader "builds" the subject himself by solving the exercises usually appended by hints. It makes all the elements of the theory natural to the reader during study. This way is a little bit more time consuming when compared with other textbooks dealing with this subject. It provides good starting point for study of mathematical aspects of the general relativity and field theories. I recommend this book to everybody who wants to understand fundamental concepts in differential geometry in detail.

12 of 15 people found the following review helpful.

Fairly good content, very bad exposition

By TreeTiger

There's no doubt about it: the material in this book is incredibly interesting and important for an ambitious physics student. The organization of the book is fairly good: informal passages relating the necessary theory alternate with exercises which are all written as "Check that..." or "Prove that...", which allows you to choose which results to prove and which to take as given facts if you -- for any reason -- don't feel like proving them.

However, the book also has some serious shortcomings. The most important one seems to be the horrid style.

A book of mathematics for physicists should not be written just like a standard math textbook without proofs -- and this is exactly what this book is like. The definitions that are given are "mathematical" at heart; very rarely can one find an intuitive picture of what is going on immediately after a concept is introduced. On the other hand, the propositions that are not left as exercises are never proven. Granted, they might be intuitively clear, but that doesn't mean that their proofs are obvious. Due to all this, I have always felt a bit confused and certainly not comfortable with new concepts. The author's occasional attempts to "raise morale" by inserting jokes would always backfire because these jokes are so trivial that they seem offensively condescending. Take, for example, the sentence that finishes the introduction of a vector as the equivalence class of tangency of curves:

"And a good old arrow, which cannot be thought of apart from the vector, could be put at P in the direction of this bunch, too (so that it does not feel sick at heart that it had been forgotten because of some dubious novelties)." (p. 25)

So... first of all, this is probably not particularly funny. But more seriously: are we to conclude that the notion of vectors as "directed lines" is important only because otherwise the "good old arrow" (and the reader alike) would feel "sick at heart"? This is an example of a concept so intuitive that a joke like this is generally harmless; however, trouble arises when the same kind of explanation is applied to more abstract concepts (e.g. why not study non-Hausdorff spaces? The explanation given on p. 4 relates to Amazon Basin Indians).

Another important issue is that a large part of this book teaches you the principles of the mathematics behind the physics. This is fine, provided you learn how to operate with these principles; however, the book seldom teaches you how to *work* with the most basic concepts, and that's what the author promises to deliver in the preface.

Unfortunately, there are other issues as well. Introducing new, vital ideas in exercises *only* is one of them. Also, one would desire to know which ideas are crucial or well-worth meditating upon, and this is generally not given in the text. Finally, the excessively informal style prevents this book from being even a good reference.

All in all -- it is possible to learn a lot of new things from this book, but the effort probably isn't worth it.

8 of 11 people found the following review helpful.

The best book on the subject

By Ark

Before discovering the new book by Marian Fecko I thought I know all that I need about differential geometry (I co-authored a monograph on this subject myself). I had my favorite books: Kobayashi-Nomizu, Bishop-Crittenden, Sternberg, Michor, Abraham and some more. Yet "Differential Geometry and Lie Groups for Physicists" was a completely new experience. It is written with a "soul" and covers topics that are important but missing in other books. As I was working on a paper dealing with torsion, I emailed the Author with some of my ideas and questions and got an instant answer.

Readers looking for explanations and geometrical interpretations of the abstract concepts will certainly find this book irreplaceable. Lie and covariant derivatives, parallel transport, Hodge operator, Cartan's moving frame method, Laplace-Beltrami operator, Lie groups, Maxwell equations, Clifford algebras and spin bundles, $SL(2, \mathbb{C})$, Dirac operator, Momentum map etc. etc. - all introduced and explained in a concise yet clear way, with examples and exercises.

This book should find its place on the bookshelf of everyone interested in geometrical concepts required for understanding contemporary theoretical physics.

I recommend this book to all students and professionals. It should find its place in every university library.

Just one warning: certain mathematical symbols did not find their way to the "Index of frequently used symbols" at the end of the book. The reader trying to read the book starting from p. 600 may find it necessary to spend some time going through the earlier chapters to find out the meaning of a given symbol.

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