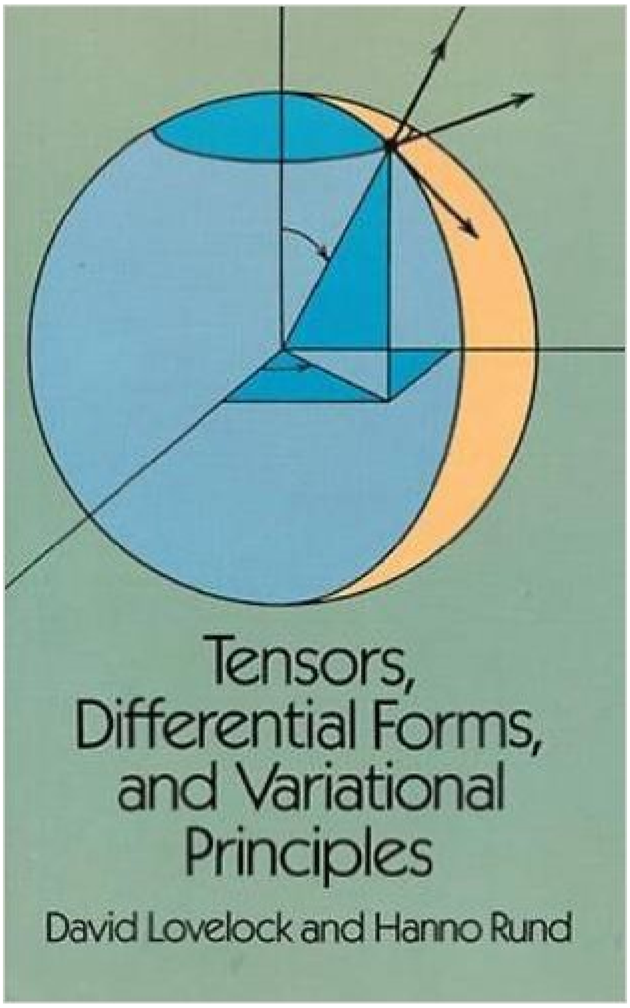
Tensors, Differential Forms, And Variational Principles (Dover Books On Mathematics)



Tensors,
Differential Forms,
and Variational
Principles

David Lovelock and Hanno Rund

Synopsis

Incisive, self-contained account of tensor analysis and the calculus of exterior differential forms, interaction between the concept of invariance and the calculus of variations. Emphasis is on analytical techniques, with large number of problems, from routine manipulative exercises to technically difficult assignments.

Book Information

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Customer Reviews

I don’t know how they did it but, this is the book you want to buy if you’re trying to learn differential geometry, especially if you’re learning general relativity. It takes you from the concepts you are already familiar with into differential geometry faster than any other book I’ve ever tried (and I’ve tried many!). Before you know it, you are comfortable with covariant derivatives and Lie derivatives and.. well the list could go on. Do not be turned off by the reputation of Dover books-- "cheap and not worth it!" This is a gem.For those of you learning GR: Buy this book and Schutz’s "Geometrical Methods of Mathematical Physics." Read Lovelock and Rund first and then dive into Schutz’s book. This will provide you with the necessary mathematical background to handle Wald’s "General Relativity" with (some amount of) ease. You might want to try Schutz’s "A First Course in General Relativity" before Wald’s more advanced book.I’ve read many glowing reviews on about books that I "must have" and, quite frankly, they turned out to be poor choices. But in this case I have to say you "must have" this book! It is that good. And it’s cheap, so if you do not agree with me, it’s not much money out of your pocket.

Many years ago, this became the first book I had ever read about tensor calculus, differential geometry, or classical field theories, and I still have not found a much better treatment of any of these subjects anywhere else.The notation is often very classical, in the sense that there are a lot of indices, usually referring to coordinate bases, and there is a lot of talk of "transformation laws." While this style can be distressing to more advanced students, those familiar with the beautiful methods of avoiding such structures, I think it is useful to younger students, especially physicists, who yearn for concrete examples. Also, for the one section in which a more formal approach is advantageous, such a treatment is included as an appendix.The book is also wonderful for its breadth. It is not a "tensor calculus" book, or a "differential geometry" book. It is really best described as a "geometrical methods" book "with applications to theoretical physics." Yet unlike most examples of this now-cliched subject, the breadth of material is matched by a cohesion of style.

As mentioned below, this book concentrates for 330+ pages on a "classical" index-based approach to tensors. Coordinate-free treatment is restricted to a brief appendix. There are only 10 illustrations in this very long book (none in the appendix). That means that you will need to concentrate very hard on the manipulation of many tiny indices in some long and hairy equations.My hat’s off to people who can learn this way, but I am in the camp that expects pictures for geometrical subjects. In this respect, Schutz is a much better book, as well as being coordinate-free from the get-go. (Ditto for Misner Thorne Wheeler and Carroll on general relativity, as well as various works by V. Arnol’d or J. Marsden that deal with this material in classical physics contexts.) I bought this book as a reference -- it might be useful also for people who want to come up with computational approaches to the material.I might have given the book 3 stars but for the facts that (i) no solutions to exercises (only some of which are in the "show that this stuff = X" format) and (ii) text is filled with "clearly"s, "obviously"s and other superfluities.

I have to side with reviewers who say this book is near perfect. The original hardcover edition was a favorite of mine when I was an undergrad and its paperback reissue by Dover is a blessing. Readers who complain about the notation may be too easily blinded. Indices are certainly used abundantly, especially in the derivation of tensor theory on affine connections, but this practice actually fits well with the authors’ objectives. By retaining traditional notation through most of the book, L&R provide the student with familiar handles to grasp, and the typesetting is the best I’ve seen for this kind of notation.A huge value of this book is how it clarifies mathematical details that many other books make confusing. The material is well-organized and guides the reader clearly through most of the derivations. L&R carefully develop (as the notes say, by successive abstraction) the theory of tensor calculus on vector spaces to that of differential forms on Riemannian manifolds. They compare the deployment of affine connections in the former and metric tensors in the latter, enabling the reader to see how curvature can be defined in either context with minimum confusion.Once differential forms are introduced, the notation becomes more modern and compact, though the use of boldface type common to "geometric" notation is nowhere in the book. Useful integral theorems of Stokes and the invariance properties of Lagrangian systems are derived in the language of differential forms. An appendix summarizing the theory of exterior calculus on differentiable manifolds closes the book.In conclusion, this book is excellent complementary reading for anyone attempting to master the mathematics essential for General Relativity theory, and in good company with other Dover reprints by Bishop & Goldberg, Flanders and Pauli. Even if you have the dough for Misner Thorne & Wheeler and the spine to lug it around, you might want these other books in your library too.

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