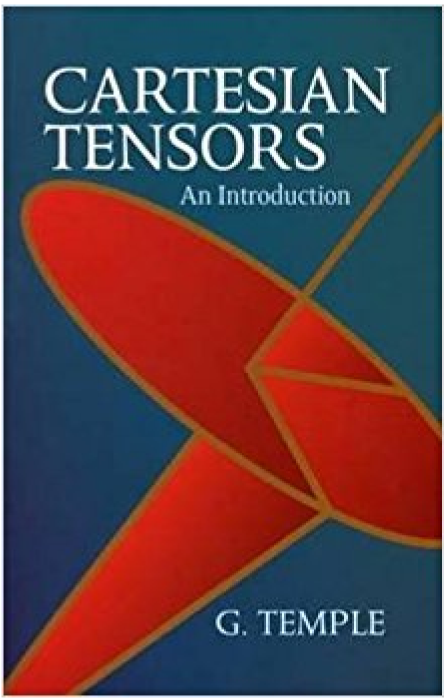
Cartesian Tensors: An Introduction (Dover Books On Mathematics)



Synopsis

This undergraduate text provides an introduction to the theory of Cartesian tensors, defining tensors as multilinear functions of direction, and simplifying many theorems in a manner that lends unity to the subject. The author notes the importance of the analysis of the structure of tensors in terms of spectral sets of projection operators as part of the very substance of quantum theory. He therefore provides an elementary discussion of the subject, in addition to a view of isotropic tensors and spinor analysis within the confines of Euclidean space. The text concludes with an examination of tensors in orthogonal curvilinear coordinates. Numerous examples illustrate the general theory and indicate certain extensions and applications. 1960 edition.

Book Information

Series: Dover Books on Mathematics

Paperback: 112 pages

Publisher: Dover Publications (September 9, 2004)

Language: English

ISBN-10: 0486439089

ISBN-13: 978-0486439082

Product Dimensions: 5.6 x 0.3 x 8.5 inches

Shipping Weight: 4.8 ounces (View shipping rates and policies)

Average Customer Review: 4.7 out of 5 stars 3 customer reviews

Best Sellers Rank: #1,268,249 in Books (See Top 100 in Books) #91 inÃ Â Books > Science & Math > Mathematics > Applied > Vector Analysis

Customer Reviews

I struggled with tensors at uni and never quite got them. Decades later I decided to have another go and this was the book I needed. If you are studying physics or engineering and are stumped by Tensors then this book will get you over the hump and moving again. Buy the book, work through it at your own pace and you will emerge at the other end with a grasp of tensors and that will be one less problem and one more tool in your armory.

As a retired physicist I never really learned hoe to use tensors, so now I’m teaching myself with excellent books like this one.

If you are a physics student trying to come to grips with tensors, Cartesian tensors are the place to start. And to kick things off, ideally I'd recommend Cartesian Tensors, by Harold Jeffreys:Ã Â Cartesian tensors. However this book is out of print, and is sometimes stupidly expensive used.This book is more difficult going than Jeffreys, but would make a good follow-up to it.Also, anyone reading this book should have a good background in Linear Algebra together with a decent introductory knowledge of Fluid Mechanics and/or Continuum Mechanics. Preferably both.There are eight chapters in this book. The first covers vectors, bases, and orthogonal transformations. The focus is on three dimensional real vectors spaces as these are the ones that are physically important, at least initially.Chapter two defines tensors. There is none of that mumbo-jumbo about contravariant verses covariant tensors as that distinction does not exist for Cartesian tensors. And that is precisely why Cartesian tensors make such a good starting point for the student of tensor calculus.Before we are greeted with the actual formal definition, the author provides us with two important, motivating examples from physics: the moment of inertia tensor, and the stress tensor from Continuum Mechanics. These are both rank two, symmetric Cartesian tensors, which are the most important nontrivial kind for the physics student to master.After the formal definition - an invariant, multilinear function of directions - we are shown how the angular velocity is properly regarded as a tensor.This chapter is very well done.The third chapter is devoted to tensor algebra. Initially, we are shown how to perform addition and scalar multiplication. The book then introduces contractions as spherical means. This is very nice. There is also some additional material in this chapter on symmetry and notation.Chapter four brings us to tensor calculus. Here again the simplicity of Cartesian tensors are clear: the components of the derivative of a tensor are given by the partial derivatives of its components. That is, covariant differentiation is just partial differentiation with no affine correction needed.Chapter five narrows the treatment to symmetric, rank 2 Cartesian tensors. This chapter spends most of its time considering the eigenvalues and eigenvectors of such tensors and their importance.Next up in Chapter six, we get a treatment of isotropic tensors. This chapter is harder going than most of the other chapters in the book as it covers some decidedly more advanced material, but any physics student should immediately appreciate the importance of the topic as they see it developed and applied to Continuum Mechanics.Chapter seven is on spinors. This chapter is actually pretty good considering that it is deeply flawed. The chapter begins with the isotropic vectors of a rotation, which are completely different that isotropic tensors unfortunately, and next introduces the isotropic parameter. This is the origin of the Cayley-Klein parameters in classical mechanics, and despite the opportunity to do so, the book neither makes the connection nor makes this new representation of rotations seem anything but very abstract. Next the isotropic parameter is recoordinatized with homogenous coordinates, and Voila!: spinors.We then are treated to a second development of spinors based on Clifford algebra, and this is very appealing for the student of quantum mechanics. However, this is where the book takes a turn for the worse. The author proves a result regarding the existence of a certain Hermetian matrix and its transpose.The result is actually quite important. Unfortunately, the matrix is Unitary, not Hermetian, and the correct operation is the adjoint, not the transpose, as is made clear in the example following this development.This hatchet job is quite hard to understand as the author actually published a proof of this result, correct I assume, in a journal, so presumably knows it well.It was primarily for this mutilation of a difficult to grasp subject that I gave the book only four stars.The last chapter digs some ways into curvilinear coordinates, and although this is definitely straying from the pure path of Cartesian tensors, this chapter was just excellent. It provides the most cogent discussion for the orthogonal curvilinear coordinates of our friends div, grad, and curl from vector calculus that I have ever seen. And I’ve seen quite a few. Unfortunately, the really tricky bits are buried in some "Levi-Civita magic" that passes without comment, but is well worth the trouble to work out.But this chapter goes further by next developing the transformation formula for the strain tensor in orthogonal curvilinear coordinates before finally discussing the divergence of the stress tensor in curvilinear coordinates. These topics are of primary importance to the student of continuum mechanics, and the first definitely requires considerably more sophistication than the easily found vector calculus formulas already derived.This chapter is excellent.Overall, a good book with some particularly bright points. Just beware the mess in the spinor chapter. There’s still quite a bit good there, but you will have to read and consider carefully.

Introductory Survey of Operators, Eigenvalues, and Linear Vector Spaces (Dover Books on Mathematics) The Nature and Power of Mathematics (Dover Books on Mathematics) Mathematics for the Nonmathematician (Dover Books on Mathematics) Understanding Infinity: The Mathematics of Infinite Processes (Dover Books on Mathematics) Mathematics and the Physical World (Dover Books on Mathematics) Concepts of Modern Mathematics (Dover Books on Mathematics) Undecidable Theories: Studies in Logic and the Foundation of Mathematics (Dover Books on Mathematics) Mathematics for Operations Research (Dover Books on Mathematics) Introduction to the Mathematics of Inversion in Remote Sensing (Dover Phoenix Editions) (Dover Phoneix Editions) Structural Geology Algorithms: Vectors and Tensors