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Assuming only a knowledge of basic calculus, this text's elementary development of tensor theory focuses on concepts related to vector analysis. The book also forms an introduction to metric differential geometry. 1962 edition.

DIVProceeds from general to special, including chapters on vector analysis on manifolds and integration theory.
/div

The tensorial nature of a quantity permits us to formulate transformation rules for its components under a change of basis. These rules are relatively simple and easily grasped by any engineering student familiar with matrix operators in linear algebra. More complex problems arise when one considers the tensor fields that describe continuum bodies. In this case general curvilinear coordinates become necessary. The principal basis of a curvilinear system is constructed as a set of vectors tangent to the coordinate lines. Another basis, called the dual basis, is also constructed in a special manner. The existence of these two bases is responsible for the mysterious covariant and contravariant terminology encountered in tensor discussions. A tensor field is a tensor-valued function of position in space. The use of tensor fields allows us to present physical laws in a clear, compact form. A byproduct is a set of simple and clear

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rules for the representation of vector differential operators such as gradient, divergence, and Laplacian in curvilinear coordinate systems. This book is a clear, concise, and self-contained treatment of tensors, tensor fields, and their applications. The book contains practically all the material on tensors needed for applications. It shows how this material is applied in mechanics, covering the foundations of the linear theories of elasticity and elastic shells. The main results are all presented in the first four chapters. The remainder of the book shows how one can apply these results to differential geometry and the study of various types of objects in continuum mechanics such as elastic bodies, plates, and shells. Each chapter of this new edition is supplied with exercises and problems most with solutions, hints, or answers to help the reader progress. An extended appendix serves as a handbook-style summary of all important formulas contained in the book. Introductory text, geared toward advanced undergraduate and graduate students, applies mathematics of Cartesian and general tensors to physical field theories and demonstrates them in terms of the theory of fluid mechanics. 1962 edition. Tensors have numerous applications in physics and engineering. There is often a fuzzy haze surrounding the concept of tensor that puzzles many students. The old-fashioned definition is difficult to understand because it is not rigorous; the modern definitions are difficult to understand because they are rigorous but at a cost of being more abstract and less intuitive. The goal of this book is to elucidate the concepts in an intuitive way but

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without loss of rigor, to help students gain deeper understanding. As a result, they will not need to recite those definitions in a parrot-like manner any more. This volume answers common questions and corrects many misconceptions about tensors. A large number of illuminating illustrations helps the reader to understand the concepts more easily. This unique reference text will benefit researchers, professionals, academics, graduate students and undergraduate students.

"Remarkably comprehensive, concise and clear." — Industrial Laboratories "Considered as a condensed text in the classical manner, the book can well be recommended." — Nature Here is a clear introduction to classic vector and tensor analysis for students of engineering and mathematical physics. Chapters range from elementary operations and applications of geometry, to application of vectors to mechanics, partial differentiation, integration, and tensor analysis. More than 200 problems are included throughout the book. Concepts from Tensor Analysis and Differential Geometry discusses coordinate manifolds, scalars, vectors, and tensors. The book explains some interesting formal properties of a skew-symmetric tensor and the curl of a vector in a coordinate manifold of three dimensions. It also explains Riemann spaces, affinely connected spaces, normal coordinates, and the general theory of extension. The book explores differential invariants, transformation groups, Euclidean metric space, and the Frenet formulae. The text describes curves in

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space, surfaces in space, mixed surfaces, space tensors, including the formulae of Gauss and Weingarten. It presents the equations of two scalars K and Q which can be defined over a regular surface S in a three dimensional Riemannian space R . In the equation, the scalar K , which is an intrinsic differential invariant of the surface S , is known as the total or Gaussian curvature and the scalar U is the mean curvature of the surface. The book also tackles families of parallel surfaces, developable surfaces, asymptotic lines, and orthogonal ennuples. The text is intended for a one-semester course for graduate students of pure mathematics, of applied mathematics covering subjects such as the theory of relativity, fluid mechanics, elasticity, and plasticity theory.

Originally published: New York: John Wiley & Sons, Inc., 1947.

This is a comprehensive self-contained text suitable for use by undergraduate mathematics, science and engineering students following courses in vector analysis. The earlier editions have been used extensively in the design and teaching of many undergraduate courses. Vectors are introduced in terms of Cartesian components, an approach which is found to appeal to many students because of the basic algebraic rules of composition of vectors and the definitions of gradient divergence and curl are thus made particularly simple. The theory is

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complete, and intended to be as rigorous as possible at the level at which it is aimed.

Understanding tensors is essential for any physics student dealing with phenomena where causes and effects have different directions. A horizontal electric field producing vertical polarization in dielectrics; an unbalanced car wheel wobbling in the vertical plane while spinning about a horizontal axis; an electrostatic field on Earth observed to be a magnetic field by orbiting astronauts—these are some situations where physicists employ tensors. But the true beauty of tensors lies in this fact: When coordinates are transformed from one system to another, tensors change according to the same rules as the coordinates. Tensors, therefore, allow for the convenience of coordinates while also transcending them. This makes tensors the gold standard for expressing physical relationships in physics and geometry. Undergraduate physics majors are typically introduced to tensors in special-case applications. For example, in a classical mechanics course, they meet the "inertia tensor," and in electricity and magnetism, they encounter the "polarization tensor." However, this piecemeal approach can set students up for misconceptions when they have to learn about tensors in more advanced physics and mathematics studies (e.g., while enrolled in a graduate-level general relativity course or when studying non-Euclidean geometries

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in a higher mathematics class). Dwight E.

Neuenschwander's *Tensor Calculus for Physics* is a bottom-up approach that emphasizes motivations before providing definitions. Using a clear, step-by-step approach, the book strives to embed the logic of tensors in contexts that demonstrate why that logic is worth pursuing. It is an ideal companion for courses such as mathematical methods of physics, classical mechanics, electricity and magnetism, and relativity. Revised and updated throughout, this book presents the fundamental concepts of vector and tensor analysis with their corresponding physical and geometric applications - emphasizing the development of computational skills and basic procedures, and exploring highly complex and technical topics in simplified settings.; This text: incorporates transformation of rectangular cartesian coordinate systems and the invariance of the gradient, divergence and the curl into the discussion of tensors; combines the test for independence of path and the path independence sections; offers new examples and figures that demonstrate computational methods, as well as clarify concepts; introduces subtitles in each section to highlight the appearance of new topics; provides definitions and theorems in boldface type for easy identification. It also contains numerical exercises of varying levels of difficulty and many problems solved.

Vector and Tensor Analysis with Applications Courier

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This book introduces students to vector analysis, a concise way of presenting certain kinds of equations and a natural aid for forming mental pictures of physical and geometrical ideas. Students of the physical sciences and of physics, mechanics, electromagnetic theory, aerodynamics and a number of other fields will find this a rewarding and practical treatment of vector analysis. Key points are made memorable with the hundreds of problems with step-by-step solutions, and many review questions with answers.

This book presents tensors and tensor analysis as primary mathematical tools for engineering and engineering science students and researchers. The discussion is based on the concepts of vectors and vector analysis in three-dimensional Euclidean space, and although it takes the subject matter to an advanced level, the book starts with elementary geometrical vector algebra so that it is suitable as a first introduction to tensors and tensor analysis. Each chapter includes a number of problems for readers to solve, and solutions are provided in an Appendix at the end of the text. Chapter 1 introduces the necessary mathematical foundations for the chapters that follow, while Chapter 2 presents the equations of motions for bodies of continuous material. Chapter 3 offers a general definition of tensors and tensor fields in three-dimensional Euclidean space. Chapter 4 discusses a new family of tensors related to the deformation of continuous material. Chapter 5 then addresses constitutive equations for elastic materials and viscous fluids, which are presented as tensor equations relating the tensor concept of stress to the tensors describing deformation, rate of deformation and rotation. Chapter 6 investigates general coordinate systems in three-dimensional Euclidean space and Chapter 7 shows how the tensor equations discussed in

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chapters 4 and 5 are presented in general coordinates.

Chapter 8 describes surface geometry in three-dimensional Euclidean space, Chapter 9 includes the most common integral theorems in two- and three-dimensional Euclidean space applied in continuum mechanics and mathematical physics.

This text was designed as a short introductory course to give students the tools of vector algebra and calculus, as well as a brief glimpse into the subjects' manifold applications. 1957 edition. 86 figures.

Examines general Cartesian coordinates, the cross product, Einstein's special theory of relativity, bases in general coordinate systems, maxima and minima of functions of two variables, line integrals, integral theorems, and more. 1963 edition.

Tensor Analysis and Nonlinear Tensor Functions embraces the basic fields of tensor calculus: tensor algebra, tensor analysis, tensor description of curves and surfaces, tensor integral calculus, the basis of tensor calculus in Riemannian spaces and affinely connected spaces, - which are used in mechanics and electrodynamics of continua, crystallophysics, quantum chemistry etc. The book suggests a new approach to definition of a tensor in space R^3 , which allows us to show a geometric representation of a tensor and operations on tensors. Based on this approach, the author gives a mathematically rigorous definition of a tensor as an individual object in arbitrary linear, Riemannian and other spaces for the first time. It is the first book to present a systematized theory of tensor invariants, a theory of nonlinear anisotropic tensor functions and a theory of indifferent tensors describing the physical properties of continua. The book will be useful for students and postgraduates of mathematical, mechanical engineering and physical departments of universities and also for investigators and academic scientists working in

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continuum mechanics, solid physics, general relativity, crystallophysics, quantum chemistry of solids and material science.

There is a large gap between engineering courses in tensor algebra on one hand, and the treatment of linear transformations within classical linear algebra on the other. This book addresses primarily engineering students with some initial knowledge of matrix algebra. Thereby, mathematical formalism is applied as far as it is absolutely necessary. Numerous exercises provided in the book are accompanied by solutions enabling autonomous study. The last chapters deal with modern developments in the theory of isotropic and anisotropic tensor functions and their applications to continuum mechanics and might therefore be of high interest for PhD-students and scientists working in this area.

Vectors and tensors are among the most powerful problem-solving tools available, with applications ranging from mechanics and electromagnetics to general relativity. Understanding the nature and application of vectors and tensors is critically important to students of physics and engineering. Adopting the same approach used in his highly popular *A Student's Guide to Maxwell's Equations*, Fleisch explains vectors and tensors in plain language. Written for undergraduate and beginning graduate students, the book provides a thorough grounding in vectors and vector calculus before transitioning through contra and covariant components to tensors and their applications. Matrices and their algebra are reviewed on the book's supporting website, which also features interactive solutions to every problem in the text where students can work through a series of hints or choose to see the entire solution at once. Audio podcasts give students the opportunity to hear important concepts in the book explained by the author.

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This is a comprehensive and self-contained text suitable for use by undergraduate mathematics, science and engineering students. Vectors are introduced in terms of cartesian components, making the concepts of gradient, divergent and curl particularly simple. The text is supported by copious examples and progress can be checked by completing the many problems at the end of each section. Answers are provided at the back of the book.

Concise, readable text ranges from definition of vectors and discussion of algebraic operations on vectors to the concept of tensor and algebraic operations on tensors. Worked-out problems and solutions. 1968 edition.

Vector Analysis and Cartesian Tensors, Second Edition focuses on the processes, methodologies, and approaches involved in vector analysis and Cartesian tensors, including volume integrals, coordinates, curves, and vector functions. The publication first elaborates on rectangular Cartesian coordinates and rotation of axes, scalar and vector algebra, and differential geometry of curves. Discussions focus on differentiation rules, vector functions and their geometrical representation, scalar and vector products, multiplication of a vector by a scalar, and angles between lines through the origin. The text then elaborates on scalar and vector fields and line, surface, and volume integrals, including surface, volume, and repeated integrals, general orthogonal curvilinear coordinates, and vector components in orthogonal curvilinear coordinates. The manuscript ponders on representation theorems for isotropic tensor functions, Cartesian tensors, applications in potential theory, and integral theorems. Topics include geometrical and physical significance of divergence and curl, Poisson's equation in vector form, isotropic scalar functions of symmetrical second order tensors, and diagonalization of second-order symmetrical tensors. The publication is a valuable reference

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for mathematicians and researchers interested in vector analysis and Cartesian tensors.

To Volume 1 This work represents our effort to present the basic concepts of vector and tensor analysis. Volume 1 begins with a brief discussion of algebraic structures followed by a rather detailed discussion of the algebra of vectors and tensors. Volume 2 begins with a discussion of Euclidean manifolds, which leads to a development of the analytical and geometrical aspects of vector and tensor fields. We have not included a discussion of general differentiable manifolds.

However, we have included a chapter on vector and tensor fields defined on hypersurfaces in a Euclidean manifold. In preparing this two-volume work, our intention was to present to engineering and science students a modern introduction to vectors and tensors. Traditional courses on applied mathematics have emphasized problem-solving techniques rather than the systematic development of concepts. As a result, it is possible for such courses to become terminal mathematics courses rather than courses which equip the student to develop his or her understanding further.

Through several centuries there has been a lively interaction between mathematics and mechanics. On the one side, mechanics has used mathematics to formulate the basic laws and to apply them to a host of problems that call for the quantitative prediction of the consequences of some action. On the other side, the needs of mechanics have stimulated the development of mathematical concepts. Differential calculus grew out of the needs of Newtonian dynamics; vector algebra was developed as a means to describe force systems; vector analysis, to study velocity fields and force fields; and the calculus of variations has evolved from the energy principles of mechanics. In recent times the theory of tensors has attracted the attention of the mechanics people. Its very name indicates its origin in the theory of elasticity. For

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a long time little use has been made of it in this area, but in the last decade its usefulness in the mechanics of continuous media has been widely recognized. While the undergraduate textbook literature in this country was becoming "vectorized" (lagging almost half a century behind the development in Europe), books dealing with various aspects of continuum mechanics took to tensors like fish to water. Since many authors were not sure whether their readers were sufficiently familiar with tensors~ they either added' a chapter on tensors or wrote a separate book on the subject.

This rigorous and advanced mathematical explanation of classic tensor analysis was written by one of the founders of tensor calculus. Its concise exposition of the mathematical basis of the discipline is integrated with well-chosen physical examples of the theory, including those involving elasticity, classical dynamics, relativity, and Dirac's matrix calculus. 1954 edition.

Reflecting the significant contributions of Russian mathematicians to the field, this book contains a selection of papers on tensor and vector analysis. It is divided into three parts, covering Hamiltonian systems, Riemannian geometry and calculus of variations, and topology. The range of applications of these topics is very broad, as many modern geometrical problems recur across a wide range of fields, including mechanics and physics as well as mathematics. Many of the approaches to problems presented in this volume will be novel to the Western reader, although questions are of global interest. The

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main achievements of the Russian school are placed in the context of the development of each individual subject.

This book provides a systematic development of tensor methods in statistics, beginning with the study of multivariate moments and cumulants. The effect on moment arrays and on cumulant arrays of making linear or affine transformations of the variables is studied. Because of their importance in statistical theory, invariant functions of the cumulants are studied in some detail. This is followed by an examination of the effect of making a polynomial transformation of the original variables. The fundamental operation of summing over complementary set partitions is introduced at this stage. This operation shapes the notation and pervades much of the remainder of the book. The necessary lattice-theory is discussed and suitable tables of complementary set partitions are provided. Subsequent chapters deal with asymptotic approximations based on Edgeworth expansion and saddlepoint expansion. The saddlepoint expansion is introduced via the Legendre transformation of the cumulant generating function, also known as the conjugate function of the cumulant generating function. A recurring theme is that, with suitably chosen notation, multivariate calculations are often simpler and more transparent than the corresponding univariate calculations. The final two

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chapters deal with likelihood ratio statistics, maximum likelihood estimation and the effect on inferences of conditioning on ancillary or approximately ancillary statistics. The Bartlett adjustment factor is derived in the general case and simplified for certain types of generalized linear models. Finally, Barndorff-Nielsen's formula for the conditional distribution of the maximum likelihood estimator is derived and discussed. More than 200 Exercises are provided to illustrate the uses of tensor methodology.

DIVTensor theory, applications to dynamics, electricity, elasticity, hydrodynamics, etc. Level is advanced undergraduate. Over 500 solved problems. /div

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