The Mathematical Theory Of Special And General Relativity

This fascinating book is a treatise on real space-age materials. It is a mathematical treatment of a novel concept in material science that characterizes the properties of dynamic materials—that is, material substances whose properties are variable in space and time. Unlike conventional composites that are often found in nature, dynamic materials are mostly the products of modern technology developed to maintain the most effective control over dynamic processes. An overview of special functions, focusing on the hypergeometric functions and the associated hypergeometric series. This mathematically rigorous treatment examines Zeeman's characterization of the causal automorphisms of Minkowski spacetime and the Penrose theorem concerning the apparent shape of a relativistically moving sphere. Other topics include the construction of a geometric theory of the electromagnetic field; an in-depth introduction to the theory of spinors; and a classification of electromagnetic fields in both tensor and spinor form. Appendixes introduce a topology for Minkowski spacetime and discuss Dirac's famous "Scissors Problem." Appropriate for graduate-level courses, this text presumes only a knowledge of linear algebra and elementary point-set topology. 1992 edition. 43 figures. This book has been considered by academicians and scholars of great significance and value to literature. This

forms a part of the knowledge base for future generations. So that the book is never forgotten we have represented this book in a print format as the same form as it was originally first published. Hence any marks or annotations seen are left intentionally to preserve its true nature.

This book describes Carmeli's cosmological general and special relativity theory, along with Einstein's general and special relativity. These theories are discussed in the context of Moshe Carmeli's original research, in which velocity is introduced as an additional independent dimension. Four- and five-dimensional spaces are considered, and the five-dimensional braneworld theory is presented. The Tully-Fisher law is obtained directly from the theory, and thus it is found that there is no necessity to assume the existence of dark matter in the halo of galaxies, nor in galaxy clusters.The book gives the derivation of the Lorentz transformation, which is used in both Einstein's special relativity and Carmeli's cosmological special relativity theory. The text also provides the mathematical theory of curved spacetime geometry, which is necessary to describe both Einstein's general relativity and Carmeli's cosmological general relativity. A comparison between the dynamical and kinematic aspects of the expansion of the universe is made. Comparison is also made between the Friedmann-Robertson-Walker theory and the Carmeli theory. And neither is it necessary to assume the existence of dark matter to correctly describe the expansion of the cosmos.

Comprehensive text provides a detailed treatment of

orthogonal polynomials, principal properties of the gamma function, hypergeometric functions, Legendre functions, confluent hypergeometric functions, and Hill's equation.

The book expounds the major topics in the special theory of relativity. It provides a detailed examination of the mathematical foundation of the special theory of relativity, relativistic mass, relativistic mechanics and relativistic electrodynamics. As well as covariant formulation of relativistic mechanics and electrodynamics, the book discusses the relativistic effect on photons. Using a mathematical approach, the text offers graduate students a clear, concise view of the special theory of relativity. Organized into 14 chapters and two appendices, the content is presented in a logical order, and every topic has been dealt with in a simple and lucid manner. To aid understanding of the subject, the book provides numerous relevant worked examples in every chapter. The book's mathematical approach helps students in their independent study and motivates them to research the topic further.

This introduction to the theory of Sobolev spaces and Hilbert space methods in partial differential equations is geared toward readers of modest mathematical backgrounds. It offers coherent, accessible demonstrations of the use of these techniques in developing the foundations of the theory of finite element approximations. J. T. Oden is Director of the Institute for Computational Engineering & Sciences (ICES) at the University of

Texas at Austin, and J. N. Reddy is a Professor of Engineering at Texas A&M University. They developed this essentially self-contained text from their seminars and courses for students with diverse educational backgrounds. Their effective presentation begins with introductory accounts of the theory of distributions, Sobolev spaces, intermediate spaces and duality, the theory of elliptic equations, and variational boundary value problems. The second half of the text explores the theory of finite element interpolation, finite element methods for elliptic equations, and finite element methods for initial boundary value problems. Detailed proofs of the major theorems appear throughout the text, in addition to numerous examples.

A special algebra is proposed for applied mathematics. A special algebra is developed specifically for discovering new theory inside the present theory of Special Relativity. In the book's climax, the special algebra unites Maxwell's Equations into the Dirac Equation to form a mathematical model of physics that combines the dynamics of a photon with the dynamics of an electron. An electron projects itself as a photon, per the application of the special algebra. The special algebra that leads to this climax is derived from a proof of irrationality of an irrational number. The place-value digits of an irrational number that are beyond a specific finite maximum in count are each

unknown and unknowable, analogous to Schrödinger's Cat. Through use of the special algebra, the double existence of Schrödinger's Cat leads to the double existence of the electron/photon particle. The special algebra is derived from a proposed axiom that replaces Cantor's Continuum Hypothesis, from which the real numbers were derived. The mathematics is simple enough to be understood by a high school student who has taken first year level college math and physics classes (and is familiar with trigonometry and logarithms, complex numbers, matrix multiplication, geometric-unit-vectors, and partial differential equations). Visualizations and examples help the reader comprehend each subtle feature in the algebra. Each chapter has exercises so that the reader can check their comprehension. The book was written to be quickly read and easily understood, and the book includes the mathematical details. SPECIAL ALGEBRA FOR SPECIAL RELATIVITY o Derives a proper replacement for infinity for use in applied mathematics o Proposes a new theory for electromagnetism o Pushes hypercomplex number algebra to the extremes o Combines anti-matter, electromagnetism, matter-waves, and time-space Preface - The real numbers, defined per Cantor's Continuum Hypothesis, are replaced by a new set of numbers. The new set of numbers are defined per a proposed new axiom that is consistent with the

proofs that specific numbers are irrational. By use of the mathematical operation of the Lorentz Transformation, the new set of numbers is applied to the existing mathematical model of the Dirac Equation to result in Maxwell's Equations. Unlike the real numbers, the new set of numbers has no dependency on an actual infinity. In base two, the new set of numbers has known or knowable place-value digits after the decimal point that extend to a finite count of place-value digits. Beyond that count, the place-value digits are unknown and unknowable. An unknown and unknowable place-value digit in base two is an analogy to Schrödinger's Cat. For example, in geometric space, the right triangle with two unit length sides has a finite imprecision to each unit length side because the quantity of zeros after the decimal point is a finite count. The quantity of zeros is not infinite per Cantor's theory of infinite sets, and is not the ultimate quantity of zeros as is assumed for an integer through the process of truncation at the decimal point. The length of the hypotenuse is similarly imprecise. The unknown and unknowable place-value digits after the decimal point cannot all be/become zero if replaced randomly with a one or a zero because there is no end to their count, and, therefore, a division reciprocal exists for the unknown and unknowable place-value digits. The division reciprocal is the proper replacement for an actual infinity because it may be used in applied

mathematics. The division reciprocal is used in the Lorentz Transformation to model motion at the speed of light. The claim of applicability of the new set of numbers to applied mathematics is based on the correct calculation of the measured electromagnetic force density, by use of the complex conjugate of the Dirac Spinor.

See the back of the book's cover for a description. This volume is based on a course of lectures delivered at the St. Petersburg State University (Russia) and at Ohio State University (Columbus). It is intended as a textbook for graduate students and postdocs. The book presents the theory of records and some information on order statistics. Also included are exercises illustrating the examples and developing the ideas. The past 20 years has seen tremendous progress in the topic, giving forth a large number of new models that reflect the dynamics of records in a wide range of areas. This volume presents systematic main results with a special emphasis on non-classical record schemes. The material is presented in a comprehensive style succinctly outlining the current state of the theory. The work is geared toward statisticians, actuarians, engineers, hydrologists, meteorologists, and sports and market analysts.

This monograph aims to lay the groundwork for the design of a unified mathematical approach to the modeling and analysis of large, complex systems

composed of interacting living things. Drawing on
twenty years of research in various scientific fields, it
explores how mathematical kinetic theory and
evolutionary game theory can be used to understand
the complex interplay between mathematical
sciences and the dynamics of living systems. The
authors hope this will contribute to the development
of new tools and strategies, if not a new
mathematical theory. The first chapter discusses the
main features of living systems and outlines a
strategy for their modeling. The following chapters
then explore some of the methods needed to
potentially achieve this in practice. Chapter Two
provides a brief introduction to the mathematical
kinetic theory of classical particles, with special
emphasis on the Boltzmann equation; the Enskog
equation, mean field models, and Monte Carlo
methods are also briefly covered. Chapter Three
uses concepts from evolutionary game theory to
derive mathematical structures that are able to
capture the complexity features of interactions within
living systems. The book then shifts to exploring the
relevant applications of these methods that can
potentially be used to derive specific, usable models.
The modeling of social systems in various contexts
is the subject of Chapter Five, and an overview of
modeling crowd dynamics is given in Chapter Six,
demonstrating how this approach can be used to
model the dynamics of multicellular systems. The

final chapter considers some additional applications before presenting an overview of open problems. The authors then offer their own speculations on the conceptual paths that may lead to a mathematical theory of living systems hoping to motivate future research activity in the field. A truly unique contribution to the existing literature, A Quest Toward a Mathematical Theory of Living Systems is an important book that will no doubt have a significant influence on the future directions of the field. It will be of interest to mathematical biologists, systems biologists, biophysicists, and other researchers working on understanding the complexities of living systems.

This monograph has the ambitious aim of developing a mathematical theory of complex biological systems with special attention to the phenomena of ageing, degeneration and repair of biological tissues under individual self-repair actions that may have good potential in medical therapy.The approach to mathematically modeling biological systems needs to tackle the additional difficulties generated by the peculiarities of living matter. These include the lack of invariance principles, abilities to express strategies for individual fitness, heterogeneous behaviors, competition up to proliferative and/or destructive actions, mutations, learning ability, evolution and many others. Applied mathematicians in the field of living systems, especially biological

systems, will appreciate the special class of integro-differential equations offered here for modeling at the molecular, cellular and tissue scales. A unique perspective is also presented with a number of case studies in biological modeling.

The general concept of information is here, for the first time, defined mathematically by adding one single axiom to the probability theory. This Mathematical Theory of Information is explored in fourteen chapters: 1. Information can be measured in different units, in anything from bits to dollars. We will here argue that any measure is acceptable if it does not violate the Law of Diminishing Information. This law is supported by two independent arguments: one derived from the Bar-Hillel ideal receiver, the other is based on Shannon's noisy channel. The entropy in the 'classical information theory' is one of the measures conforming to the Law of Diminishing Information, but it has, however, properties such as being symmetric, which makes it unsuitable for some applications. The measure reliability is found to be a universal information measure. 2. For discrete and finite signals, the Law of Diminishing Information is defined mathematically, using probability theory and matrix algebra. 3. The Law of Diminishing Information is used as an axiom to derive essential properties of information. Byron's law: there is more information in a lie than in gibberish. Preservation: no information is lost in a

reversible channel. Etc. The Mathematical Theory of Information supports colligation, i. e. the property to bind facts together making 'two plus two greater than four'. Colligation is a must when the information carries knowledge, or is a base for decisions. In such cases, reliability is always a useful information measure. Entropy does not allow colligation.

This introduction to the mathematical foundations of quantum field theory is based on operator algebraic methods and emphasizes the link between the mathematical formulations and related physical concepts. The book begins with a general probabilistic description of physics, encompassing both classical and quantum physics, and presents the key physical notions before introducing operator algebraic methods. Operator algebra is then used to develop the theory of special relativity, scattering theory, and sector theory.

Scientific knowledge grows at a phenomenal pace--but few books have had as lasting an impact or played as important a role in our modern world as The Mathematical Theory of Communication, published originally as a paper on communication theory more than fifty years ago. Republished in book form shortly thereafter, it has since gone through four hardcover and sixteen paperback printings. It is a revolutionary work, astounding in its foresight and contemporaneity. The University of Illinois Press is pleased and honored to issue this commemorative reprinting of a classic.

This excellent 1981 treatment of the mathematical theory of entropy gives an accessible exposition its application

to other fields.

With the objective of making into a science the art of verifying computer programs (debugging), the author addresses both practical and theoretical aspects. Subjects include computability (with discussions of finite automata and Turing machines); predicate calculus; verification of programs (bloth flowchart and algol-like programs); flowchart schemas; and the fixpoint theory of programs. 1974 edition. Includes 77 figures.

This volume comprises two classic essays on the mathematical theories of elasticity and plasticity by authorities in this area of engineering science. Undergraduate and graduate students in engineering as well as professional engineers will find these works excellent texts and references. The Mathematical Theory of Elasticity covers plane stress and plane strain in the isotropic medium, holes and fillets of assignable shapes, approximate conformal mapping, reinforcement of holes, mixed boundary value problems, the third fundamental problem in two dimensions, eigensolutions for plane and axisymmetric states, anisotropic elasticity, thermal stress, elastic waves induced by thermal shock, three-dimensional contact problems, wave propagation, traveling loads and sources of disturbance, diffraction, and pulse propagation. The Mathematical Theory of Plasticity explores the theory of perfectly plastic solids, the theory of strain-hardening plastic solids, piecewise linear plasticity, minimum principles of plasticity, bending of a circular plate, and other problems.

The physicist and humanitarian took his place beside the great teachers with the publication of Relativity: The

Special and General Theory, Einstein's own popular
translation of the physics that shaped our "truths" of
space and time.
This book presents the basic theory of relativity in a
rational and simplest possible manner, with the
emphasis on the Principle of Simplicity in developing the
theory. The presentation is in the style of a discussion
and is generally devoid of unproven and speculative
assertions. In rare cases where speculative ideas are
mentioned, they are clearly stated to be such. Test
results verifying all of the theoretical results are given
and discussed. This work is intended to serve as a
resource and reference book for educational purposes.
In Parts I and II the principal results of special and
general relativity are derived rigorously, discussing the
contributions of Einstein, as well as Lorentz, Poincare,
Minkowski, Hilbert, Eddington and others, with historical
notes touching upon the various aspects of relativity.
Multiple derivations are given particularly of the mass-
energy relation, the gravitational field equation, and the
relativistic orbit of planets. The Schwarzschild metric and
its consequences leading to the formation of black holes
are treated in detail. The historical problems of physical
dilation of time and Einstein's clock paradox are treated
in an entirely new manner based upon general relativity.
The author has also presented Einstein's gravitational
radiation theory, and its application by Peters and
Mathews to radiation from orbiting bodies, followed by
the study of radiation from a certain binary pulsar by
Weisberg and Taylor. These difficult topics are treated
without taking shortcuts as is commonly done in

textbooks, but in a manner that senior students can understand. A fresh look is taken of Weyl's unification of gravitational and electromagnetic field theories, again a difficult topic avoided by textbooks. The final chapter of Part II is on the elements of field cosmology. Aspects involving particle physics are not covered because they cannot be treated even cursorily in a book of this size dealing primarily with fields; only books specializing in cosmology can do justice to that vast subject. Part III is devoted entirely to tensor calculus, and its application to the geometries of Riemann and Weyl; these are the essential tools of Einstein's and Weyl's theories treated in Part II. Finally, four appendices are provided on certain mathematical topics. Thus the book is self-contained. The book contains 11 figures, an extensive bibliography and an index. Note: (1) Mathematical and other errors corrected March 21, 2015. (2) For earlier versions, a PDF of mathematical errata will be emailed upon request for free. (3) Comments of readers are welcome and may be emailed to ashkatti34@gmail.com. This book was originally written in 1969 by Berkeley mathematician John Rhodes. It is the founding work in what is now called algebraic engineering, an emerging field created by using the unifying scheme of finite state machine models and their complexity to tie together many fields: finite group theory, semigroup theory, automata and sequential machine theory, finite phase space physics, metabolic and evolutionary biology, epistemology, mathematical theory of psychoanalysis, philosophy, and game theory. The author thus introduced a completely original algebraic approach to

complexity and the understanding of finite systems. The unpublished manuscript, often referred to as "The Wild Book," became an underground classic, continually requested in manuscript form, and read by many leading researchers in mathematics, complex systems, artificial intelligence, and systems biology. Yet it has never been available in print until now. This first published edition has been edited and updated by Chrystopher Nehaniv for the 21st century. Its novel and rigorous development of the mathematical theory of complexity via algebraic automata theory reveals deep and unexpected connections between algebra (semigroups) and areas of science and engineering. Co-founded by John Rhodes and Kenneth Krohn in 1962, algebraic automata theory has grown into a vibrant area of research, including the complexity of automata, and semigroups and machines from an algebraic viewpoint, and which also touches on infinite groups, and other areas of algebra. This book sets the stage for the application of algebraic automata theory to areas outside mathematics. The material and references have been brought up to date bythe editor as much as possible, yet the book retains its distinct character and the bold yet rigorous style of the author. Included are treatments of topics such as models of time as algebra via semigroup theory; evolution-complexity relations applicable to both ontogeny and evolution; an approach to classification of biological reactions and pathways; the relationships among coordinate systems, symmetry, and conservation principles in physics; discussion of "punctuated equilibrium" (prior to Stephen Jay Gould); games; and applications to psychology,

psychoanalysis, epistemology, and the purpose of life. The approach and contents will be of interest to a variety of researchers and students in algebra as well as to the diverse, growing areas of applications of algebra in science and engineering. Moreover, many parts of the book will be intelligible to non-mathematicians, including students and experts from diverse backgrounds. The topic of special functions, normally presented as a mere collection of functions exhibiting particular properties, is treated from a fresh and unusual perspective in this book. The authors have based the special functions on the theory of second-order ordinary differential equations in the complex domain. Several physical applications are presented. Numerous tables and figures will help the reader find his way through the subject. Knots are familiar objects. We use them to moor our boats, to wrap our packages, to tie our shoes. Yet the mathematical theory of knots quickly leads to deep results in topology and geometry. The Knot Book is an introduction to this rich theory, starting from our familiar understanding of knots and a bit of college algebra and finishing with exciting topics of current research. The Knot Book is also about the excitement of doing mathematics. Colin Adams engages the reader with fascinating examples, superb figures, and thought-provoking ideas. He also presents the remarkable applications of knot theory to modern chemistry, biology, and physics. This is a compelling book that will comfortably escort you into the marvelous world of knot theory. Whether you are a mathematics student,

someone working in a related field, or an amateur mathematician, you will find much of interest in The Knot Book.

Based on courses taught at the University of Dublin, Carnegie Mellon University, and mostly at Simon Fraser University, this book presents the special theory of relativity from a mathematical point of view. It begins with the axioms of the Minkowski vector space and the flat spacetime manifold. Then it discusses the kinematics of special relativity in terms of Lorentz tranformations, and treats the group structure of Lorentz transformations. Extending the discussion to spinors, the author shows how a unimodular mapping of spinor (vector) space can induce a proper, orthochronous Lorentz mapping on the Minkowski vector space. The second part begins with a discussion of relativistic particle mechanics from both the Lagrangian and Hamiltonian points of view. The book then turns to the relativistic (classical) field theory, including a proof of Noether's theorem and discussions of the Klein-Gordon, electromagnetic, Dirac, and non-abelian gauge fields. The final chapter deals with recent work on classical fields in an eight-dimensional covariant phase space.

Linear and nonlinear waves are a central part of the theory of PDEs. This book begins with a description of one-dimensional waves and their visualization through computer-aided techniques. Next, traveling waves are covered, such as solitary waves for the Klein-Gordon and KdV equations. Finally, the author gives a lucid discussion of waves arising from conservation laws, including shock and rarefaction waves. As an

application, interesting models of traffic flow are used to illustrate conservation laws and wave phenomena. This book is based on a course given by the author at the IAS/Park City Mathematics Institute. It is suitable for independent study by undergraduate students in mathematics, engineering, and science programs. This book is published in cooperation with IAS/Park City Mathematics Institute.

This unique textbook offers a mathematically rigorous presentation of the theory of relativity, emphasizing the need for a critical analysis of the foundations of general relativity in order to best study the theory and its implications. The transitions from classical mechanics to special relativity and then to general relativity are explored in detail as well, helping readers to gain a more profound and nuanced understanding of the theory as a whole. After reviewing the fundamentals of differential geometry and classical mechanics, the text introduces special relativity, first using the physical approach proposed by Einstein and then via Minkowski's mathematical model. The authors then address the relativistic thermodynamics of continua and electromagnetic fields in matter – topics which are normally covered only very briefly in other treatments – in the next two chapters. The text then turns to a discussion of general relativity by means of the authors' unique critical approach, underlining the difficulty of recognizing the physical meaning of some statements, such as the physical meaning of coordinates and the derivation of physical quantities from those of space-time. Chapters in this section cover the model of space-

time proposed by Schwarzschild; black holes; the Friedman equations and the different cosmological models they describe; and the Fermi-Walker derivative. Well-suited for graduate students in physics and mathematics who have a strong foundation in real analysis, classical mechanics, and general physics, this textbook is appropriate for a variety of graduate-level courses that cover topics in relativity. Additionally, it will interest physicists and other researchers who wish to further study the subtleties of these theories and understand the contemporary scholarly discussions surrounding them.

Unlike some other reproductions of classic texts (1) We have not used OCR(Optical Character Recognition), as this leads to bad quality books with introduced typos. (2) In books where there are images such as portraits, maps, sketches etc We have endeavoured to keep the quality of these images, so they represent accurately the original artefact. Although occasionally there may be certain imperfections with these old texts, we feel they deserve to be made available for future generations to enjoy.

The book aims to expound the general theory of relativity with a mathematical point of view. Catering to the needs of postgraduate students and researchers in the field of astrophysics and mathematical physics, it offers the readers a comprehensive understanding of the advanced topics of the subject matter. It specifically discusses the mathematical foundation of tensor calculus, gives a background of geodesics, Einstein's field equations, linearised gravity, spacetime of spherically symmetric distribution of matter and black holes, and particle and photon orbits in spacetime.

Apart from the formulation of general relativity, Lie derivatives and its applications, and causality of spacetime are also discussed in detail. Certain preliminary concepts of extrinsic curvature, Lagrangian formalism of general theory of relativity and 3 + 1 decomposition of space-time are covered and are provided in the book as appendices. This is an introduction to the mathematical foundations of quantum field theory, using operator algebraic methods and emphasizing the link between the mathematical formulations and related physical concepts. It starts with a general probabilistic description of physics, which encompasses both classical and quantum physics. The basic key physical notions are clarified at this point. It then introduces operator algebraic methods for quantum theory, and goes on to discuss the theory of special relativity, scattering theory, and sector theory in this context. Following Keller [119] we call two problems inverse to each other if the for mulation of each of them requires full or partial knowledge of the other. By this definition, it is obviously arbitrary which of the two problems we call the direct and which we call the inverse problem. But usually, one of the problems has been studied earlier and, perhaps, in more detail. This one is usually called the direct problem, whereas the other is the inverse problem. However, there is often another, more important difference between these two problems. Hadamard (see [91]) introduced the concept of a well-posed problem, originating from the philosophy that the mathematical model of a physical problem has to have the properties of uniqueness, existence, and stability of the solution. If one of the properties fails to hold, he called the problem ill-posed. It turns out that many interesting and important inverse in science lead to ill-posed problems, while the corresponding di problems rect problems are well-posed. Often, existence and uniqueness can be forced by enlarging

or reducing the solution space (the space of "models"). For restoring stability, however, one has to change the topology of the spaces, which is in many cases impossible because of the presence of measurement errors. At first glance, it seems to be impossible to compute the solution of a problem numerically if the solution of the problem does not depend continuously on the data, i. e. , for the case of ill-posed problems.

"The theory of black holes is the most simple consequence of Einstein's relativity theory. Dealing with relativity theory, this book details one of the most beautiful areas of mathematical physics; the theory of black holes. It represents a personal testament to the work of the author, who spent several years working-out the subject matter."--WorldCat.

Classic monograph presents connected account of mathematical theory of wave motion in a liquid with a free surface and subjected to gravitational and other forces, together with applications to concrete physical problems. 1957 edition.

This work discusses the theory of control processes. The extremely rapid growth of the theory, associated intimately with the continuing trend toward automation, makes it imperative that the courses of this nature rest upon a broad basis. The work discusses the fundamentals of the calculus of variations, dynamic programming, discrete control processes, use of the digital computer, and functional analysis. Introductory courses in control theory are essential for training the modern graduate student in pure and applied mathematics, engineering, mathematical physics, economics, biology, operations research, and related fields. The work also describes the dual approaches of the calculus of variations and dynamic programming in the scalar case and illustrates ways to tackle the multidimensional optimization problems.