An Introduction To Relativity Ldindology

This mathematically-oriented introduction takes the point of view that students should become familiar, at an early stage, with the physics of relativistic continua and thermodynamics within the framework of special relativity. Therefore, in addition to standard textbook topics such as relativistic kinematics and vacuum electrodynamics, the reader will be thoroughly introduced to relativistic continuum and fluid mechanics. There is emphasis on the 3+1 splitting technique.

Second edition of a widely-used textbook providing the first step into general relativity for undergraduate students with minimal mathematical background.

The General Theory of Relativity: A Mathematical Exposition will serve readers as a modern mathematical introduction to the general theory of relativity. Throughout the book, examples, worked-out problems, and exercises (with hints and solutions) are furnished. Topics in this book include, but are not limited to: tensor analysis the special theory of relativity the general theory of relativity and Einstein's field equations spherically symmetric solutions and experimental confirmations static and stationary space-time domains black holes cosmological models algebraic classifications and the Newman-Penrose equations the coupled Einstein-Maxwell-Klein-Gordon equations appendices covering mathematical supplements and special topics Mathematical rigor, yet very clear presentation of the topics make this book a unique text for both university students and research scholars. Anadijiban Das has taught courses on Relativity Theory at The University College of Dublin, Ireland, Jadavpur University, India, Carnegie-Mellon University, USA, and Simon Fraser University, Canada. His major areas of research include, among diverse topics, the mathematical aspects of general relativity theory. Andrew DeBenedictis has taught courses in Theoretical Physics at Simon Fraser University, Canada, and is also a member of The Pacific Institute for the Mathematical Sciences. His research interests include quantum gravity, classical gravity, and semi-classical gravity.

Simple explanations of complex ideas for your future genius Written by an expert, General Relativity for Babies is a colorfully simple introduction to Einstein's most famous theory. Babies (and grownups) will learn all about black holes, gravitational waves, and more. With a tongue-in-cheek approach that adults will love, this installment of the Baby University board book series is the perfect way to introduce basic concepts to even the youngest scientists. After all, it's never too early to become a quantum physicist Baby University: It only takes a small spark to ignite a child's mind.

Experiments on gravitation / Bruno Bertotti, Dieter Brill, and Robert Krotkov -- Exact solutions of the gravitational field equations / Jürgen Ehlers and Wolfgang Kundt -- The equations of motion / Joshua N. Goldberg -- The Cauchy problem / Yvonne Bruhat -- Conservation laws in general relativity / Andrzej Trautman -- Gravitational radiation / F.A.E. Pirani -- The dynamics of general relativity / R. Arnowitt, S. Deser, and C.W. Misner -- The quantization of geometry / Bryce S. DeWitt -- A geometric theory of the electromagnetic and gravitational fields / Louis Witten -- Geometrodynamics / John G. Fletcher -- Relativistic cosmology / O. Heckmann and E. Schücking.

This excellent textbook offers a unique take on relativity theory, setting it in its historical context. Ideal for those interested in relativity and the history of physics, the book contains a complete account of special relativity that begins with the historical analysis of the reasons that led to a change in our view of space and time. Its aim is to foster a deep understanding of relativistic spacetime and its consequences for Dynamics.

This unique textbook provides an accessible introduction to Einstein's general theory of relativity, a subject of breathtaking beauty and supreme importance in physics. With his trademark blend of wit and incisiveness, A. Zee guides readers from the fundamentals of Newtonian mechanics to the most exciting frontiers of research today, including de Sitter and anti-de Sitter spacetimes, Kaluza-Klein theory, and brane worlds. Unlike other books on Einstein gravity, this book emphasizes the action principle and group theory as guides in constructing physical theories. Zee treats various topics in a spiral style that is easy on beginners, and includes anecdotes from the history of physics that will appeal to students and experts alike. He takes a friendly approach to the required mathematics, yet does not shy away from more advanced mathematical topics such as differential forms. The extensive discussion of black holes includes rotating and extremal black holes and Hawking radiation. The ideal textbook for undergraduate and graduate students, Einstein Gravity in a Nutshell also provides an essential resource for professional physicists and is accessible to anyone familiar with classical mechanics and electromagnetism. It features numerous exercises as well as detailed appendices covering a multitude of topics not readily found elsewhere. Provides an accessible introduction to Einstein's general theory of relativity Guides readers from Newtonian mechanics to the frontiers of modern research Emphasizes symmetry and the Einstein-Hilbert action Covers topics not found in standard textbooks on Einstein gravity Includes interesting historical asides Features numerous exercises and detailed appendices Ideal for students, physicists, and scientifically minded lay readers Solutions manual (available only to teachers)

This book gives an excellent introduction to the theory of special relativity. Professor Resnick presents a fundamental and unified development of the subject with unusually clear discussions of the aspects that usually trouble beginners. He includes, for example, a section on the common sense of relativity. His presentation is lively and interspersed with historical, philosophical and special topics (such as the twin paradox) that will arouse and hold the reader's interest. You'll find many unique features that help you grasp the material, such as worked-out examples,summary tables,thought questions and a wealth of excellent problems. The emphasis throughout the book is physical. The experimental background, experimental confirmation of predictions, and the physical interpretation of principles are stressed. The book treats relativistic kinematics, relativistic dynamics, and relativity and electromagnetism and contains special appendices on the geometric representation of space-time and on general relativity. Its organization permits an instructor to vary the length and depth of his treatment and to use the book either with or following classical physics. These features make it an ideal companion for introductory courses.

Special Relativity (SR) is essentially grounded on the properties of space-time, i.e. isotropy of space and homogeneity of space and time (as a consequence of the equivalence of inertial frames) and on the Galilei principle of relativity.

This book provides a concise introduction to both the special theory of relativity and the general theory of relativity. The format is chosen to provide the basis for a single semester course which can take the students all the way from the foundations of special relativity to the core results of general relativity: the Einstein equation and the equations of motion for particles and light in curved spacetime. To facilitate access to the topics of special and general relativity for science and engineering students without prior training in relativity or geometry, the relevant geometric notions are also introduced and developed from the ground up. Students in physics, mathematics or engineering with an interest to learn Einstein's theories of relativity should be able to use this book already in the second semester of their third year. The book could also be used as the basis of a graduate level introduction to relativity for students who did not learn relativity as part of their undergraduate training.

This elementary introduction pays special attention to aspects of tensor calculus and relativity that students tend to find most difficult. Its use

of relatively unsophisticated mathematics in the early chapters allows readers to develop their confidence within the framework of Cartesian coordinates before undertaking the theory of tensors in curved spaces and its application to general relativity theory. Topics include the special principle of relativity and Lorentz transformations; orthogonal transformations and Cartesian tensors; special relativity mechanics and electrodynamics; general tensor calculus and Riemannian space; and the general theory of relativity, including a focus on black holes and gravitational waves. The text concludes with a chapter offering a sound background in applying the principles of general relativity to cosmology. Numerous exercises advance the theoretical developments of the main text, thus enhancing this volume’s appeal to students of applied mathematics and physics at both undergraduate and postgraduate levels. Preface. List of Constants. References. Bibliography.
Concise, well-written treatment of epochal theory of modern physics covers classical relativity and the relativity postulate, time dilation, the twin paradox, momentum and energy, particles of zero mass, electric and magnetic fields and forces and more. Only high school math needed. Replete with examples, ideal for self-study. Introduction. 70 illustrations.
Spacetime and Geometry is an introductory textbook on general relativity, specifically aimed at students. Using a lucid style, Carroll first covers the foundations of the theory and mathematical formalism, providing an approachable introduction to what can often be an intimidating subject. Three major applications of general relativity are then discussed: black holes, perturbation theory and gravitational waves, and cosmology. Students will learn the origin of how spacetime curves (the Einstein equation) and how matter moves through it (the geodesic equation). They will learn what black holes really are, how gravitational waves are generated and detected, and the modern view of the expansion of the universe. A brief introduction to quantum field theory in curved spacetime is also included. A student familiar with this book will be ready to tackle research-level problems in gravitational physics.
Einstein's theory of general relativity is a cornerstone of modern physics. It also touches upon a wealth of topics that students find fascinating – black holes, warped spacetime, gravitational waves, and cosmology. Now reissued by Cambridge University Press, this ground-breaking text helped to bring general relativity into the undergraduate curriculum, making it accessible to virtually all physics majors. One of the pioneers of the 'physics-first' approach to the subject, renowned relativist James B. Hartle, recognized that there is typically not enough time in a short introductory course for the traditional, mathematics-first, approach. In this text, he provides a fluent and accessible physics-first introduction to general relativity that begins with the essential physical applications and uses a minimum of new mathematics. This market-leading text is ideal for a one-semester course for undergraduates, with only introductory mechanics as a prerequisite.
This book is an elaboration of lecture notes for the graduate course on General Rela tivity given by the author at Boston University in the spring semester of 1972. It is an introduction to the subject only, as the time available for the course was limited. The author of an introduction to General Relativity is faced from the beginning with the difficult task of choosing which material to include. A general criterion as sisting in this choice is provided by the didactic character of the book: Those chapters have to be included in priority, which will be most useful to the reader in enabling him to understand the methods used in General Relativity, the results obtained so far and possibly the problems still to be solved. This criterion is not sufficient to ensure a unique choice. General Relativity has developed to such a degree, that it is impossible to include in an introductory textbook of a reasonable length even a very condensed treatment of all important problems which have been discussed until now and the author is obliged to decide, in a more or less subjective manner, which of the more recent developments to omit. The following lines indicate by means of some examples the kind of choice made in this book.
An Introduction to RelativityCambridge University Press
This book introduces the general theory of relativity and includes applications to cosmology. The book provides a thorough introduction to tensor calculus and curved manifolds. After the necessary mathematical tools are introduced, the authors offer a thorough presentation of the theory of relativity. Also included are some advanced topics not previously covered by textbooks, including Kaluza-Klein theory, Israel's formalism and branes. Anisotropic cosmological models are also included. The book contains a large number of new exercises and examples, each with separate headings. The reader will benefit from an updated introduction to general relativity including the most recent developments in cosmology.
An internationally famous physicist and electrical engineer, the author of this text was a pioneer in the investigation of gravitational waves. Joseph Weber's General Relativity and Gravitational Waves offers a classic treatment of the subject. Appropriate for upper-level undergraduates and graduate students, this text remains ever relevant. Brief but thorough in its introduction to the foundations of general relativity, it also examines the elements of Riemannian geometry and tensor calculus applicable to this field. Approximately a quarter of the contents explores theoretical and experimental aspects of gravitational radiation. The final chapter focuses on selected topics related to general relativity, including the equations of motion, unified field theories, Friedman's solution of the cosmological problem, and the Hamiltonian formulation of general relativity. Exercises. Index.
This textbook develops Special Relativity in a systematic way and offers the unique feature of having more than 200 problems with detailed solutions to empower students to gain a real understanding of this core subject in physics. This new edition has been thoroughly updated and has new sections on relativistic fluids, relativistic kinematics and on four-acceleration. The problems and solution section has been significantly expanded and short history sections have been included throughout the book. The approach is structural in the sense that it develops Special Relativity in Minkowski space following the parallel steps as the development of Newtonian Physics in Euclidian space. A second characteristic of the book is that it discusses the mathematics of the theory independently of the physical principles, so that the reader will appreciate their role in the development of the physical theory. The book is intended to be used both as a textbook for an advanced undergraduate teaching course in Special Relativity but also as a reference book for the future. In that respect it is linked to an online repository with more than 200 problems, carefully classified according to subject area and solved in detail, providing an independent problem book on Special Relativity.
The contemporary theoretical physics consists, by and large, of two independent parts. The rst is the quantum theory describing the micro-world of elementary p- ticles, the second is the theory of gravity that concerns properties of macroscopic systems such as stars, galaxies, and the universe. The relativistic theory of gr- itation which is known as general relativity was created, at the beginning of the last century, by more or less a single man from pure idea combinations and bold guessing. The task was to “marry” the theory of gravity with the theory of special relativity. The rst attempts were aimed at considering the gravitational potential as a eld in Minkowski space–time. All those attempts failed; it took 10 years until Einstein nally solved the problem. The dif culty was that the old theory of gravity as well as the young theory of special relativity had to be modi ed. The next 50 years were dif cult for this theory because its experimental basis remained weak and its complicated mathematical structure was not well understood. However, in the subsequent period this theory ourished. Thanks to improvements in the te- nology and to the big progress in the methods of astronomical observations, the amount of observable facts to which general relativity is applicable was consid- ably enlarged. This is why general relativity is, today, one of the best experimentally tested theories while many competing theories could be disproved. Also the conc- tual and mathematical fundamentals are better understood now.
Based on a course taught for years at Oxford, this book offers a concise exposition of the central ideas of general relativity. The focus is on the chain of reasoning that leads to the relativistic theory from the analysis of distance and time measurements in the presence of gravity, rather than on the underlying mathematical structure. Includes links to recent developments, including theoretical work and observational evidence, to encourage further study.
Following the approach of Lev Landau and Evgenii Lifshitz, this book introduces the theory of special and general relativity with the

Lagrangian formalism and the principle of least action. This method allows the complete theory to be constructed starting from a small number of assumptions, and is the most natural approach in modern theoretical physics. The book begins by reviewing Newtonian mechanics and Newtonian gravity with the Lagrangian formalism and the principle of least action, and then moves to special and general relativity. Most calculations are presented step by step, as is done on the board in class. The book covers recent advances in gravitational wave astronomy and provides a general overview of current lines of research in gravity. It also includes numerous examples and problems in each chapter.

Here is a book on the general relativity written by a very ordinary man with hardly any academic achievement. Why should I write a book on such a tough subject when there are any number of books written on it by very eminent persons? While all the books so far are written by experts, they are also meant for those who want to be experts too! So there was a need, which I had felt as a student, for a book meant for ordinary people like me. When I wanted to attend a course on the GR, there was this comment what will he understand the GR? it is highly mathematical involving such exotic mathematical objects like tensors!

This thorough introduction to Einstein's special theory of relativity is suitable for anyone with a minimum of one year of undergraduate physics with calculus. The authors cover every aspect of special relativity, including the impact of special relativity in quantum theory, with an introduction to relativistic quantum mechanics and quantum field theory. They also discuss the group theory of the Lorentz group, supersymmetry, and such cutting-edge topics as general relativity, the standard model of elementary particles and its extensions, and superstring theory, giving a survey of important unsolved problems. The book is accompanied by an interactive CD-ROM illustrating classic problems in relativity involving motion.

For anyone seeking a brief, clear overview of modern general relativity which emphasizes physics over mathematics, McGlinn's Introduction to Relativity is indispensable.

The revised and updated 2nd edition of this established textbook provides a self-contained introduction to the general theory of relativity, describing not only the physical principles and applications of the theory, but also the mathematics needed, in particular the calculus of differential forms. Updated throughout, the book contains more detailed explanations and extended discussions of several conceptual points, and strengthened mathematical deductions where required. It includes examples of work conducted in the ten years since the first edition of the book was published, for example the pedagogically helpful concept of a "river of space" and a more detailed discussion of how far the principle of relativity is contained in the general theory of relativity. Also presented is a discussion of the concept of the 'gravitational field' in Einstein's theory, and some new material concerning the 'twin paradox' in the theory of relativity. Finally, the book contains a new section about gravitational waves, exploring the dramatic progress in this field following the LIGO observations. Based on a long-established masters course, the book serves advanced undergraduate and graduate level students, and also provides a useful reference for researchers.

This is an excellent introduction to the subjects of gravitation and space-time structure. It discusses the foundations of Riemann geometry; the derivation of Einstein field equations; linearised theory; far fields and gravitational waves; the invariant characterisation of exact solutions; gravitational collapse; cosmology as well as alternative gravitational theories and the problem of quantum gravity.

Particle on a two-dimensional surface -- Curvilinear coordinate systems -- Particle on a two-dimensional surface--revisited -- Some tensor analysis -- Special relativity -- General relativity -- Precession of perihelion -- Gravitational redshift -- Neutron stars -- Cosmology -- Gravitational radiation -- Special topics

Provides the essential principles and results of special relativity as required by undergraduates. The text uses a geometric interpretation of space-time so that a general theory is seen as a natural extension of the special theory. Although most results are derived from first principles, complex and distracting mathematics is avoided and all mathe

What exactly did Einstein do that's so important in physics? We provide an introduction to his physics at a level accessible to an undergraduate student. All equations are worked out in detail from the beginning. Although the book is written with primarily a physics readership in mind (it can also function as a textbook), enough pedagogical support material is provided that anyone with a solid background in introductory physics (say, an engineer) can, with someeffort, understand a good part this presentation.We show why Einstein's papers were decisive to our understanding of matter as composed of molecules and atoms; why is he regarded as a foundingfather of quantum theory; how did his relativity theory bring about the new understanding that time, just like space, is relative; and how did his general relativity extend Newton's theory to new physical realm, allowing us to study black holes and cosmology.

General relativity is now an essential part of undergraduate and graduate courses in physics, astrophysics and applied mathematics. This simple, user-friendly introduction to relativity is ideal for a first course in the subject. Beginning with a comprehensive but simple review of special relativity, the book creates a framework from which to launch the ideas of general relativity. After describing the basic theory, it moves on to describe important applications to astrophysics, black hole physics, and cosmology. Several worked examples, and numerous figures and images, help students appreciate the underlying concepts. There are also 180 exercises which test and develop students' understanding of the subject. The textbook presents all the necessary information and discussion for an elementary approach to relativity. Password-protected solutions to the exercises are available to instructors at www.cambridge.org/9780521735612.

A straightforward, enjoyable guide to the mathematics of Einstein's relativity To really understand Einstein's theory of relativity – one of the cornerstones of modern physics – you have to get to grips with the underlying mathematics. This self-study guide is aimed at the general reader who is motivated to tackle that not insignificant challenge. With a user-friendly style, clear step-by-step mathematical derivations, many fully solved problems and numerous diagrams, this book provides a comprehensive introduction to a fascinating but complex subject. For those with minimal mathematical background, the first chapter gives a crash course in foundation mathematics. The reader is then taken gently by the hand and guided through a wide range of fundamental topics, including Newtonian mechanics; the Lorentz transformations; tensor calculus; the Einstein field equations; the Schwarzschild solution (which gives a good approximation of the spacetime of our Solar System); simple black holes, relativistic cosmology and gravitational waves. Special relativity helps explain a huge range of non-gravitational physical phenomena and has some strangely counter-intuitive consequences. These include time dilation, length contraction, the relativity of simultaneity, mass-energy equivalence and an absolute speed limit. General relativity, the leading theory of gravity, is at the heart of our understanding of cosmology and black holes. "I must observe that the theory of relativity resembles a building consisting of two separate stories, the special theory and the general theory. The special theory, on which the general theory rests, applies to all physical phenomena with the exception of gravitation; the general theory provides the law of gravitation and its relations tothe other forces of nature." – Albert Einstein, 1919 Understand even the basics of Einstein's amazing theory and the world will never seem the same again. Contents: Preface Introduction 1 Foundation mathematics 2 Newtonian mechanics 3 Special relativity 4 Introducing the manifold 5 Scalars, vectors, one-forms and tensors 6 More on curvature 7 General relativity 8 The Newtonian limit 9 The Schwarzschild metric 10 Schwarzschild black holes 11 Cosmology 12 Gravitational waves Appendix: The Riemann curvature tensor Bibliography Acknowledgements January 2019. This third edition has been revised to make the material even more accessible to the enthusiastic general reader who seeks to understand the mathematics of relativity.