

Undergraduate Lecture Notes in Physics

José Natário

General Relativity Without Calculus

A Concise Introduction to the Geometry
of Relativity



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Subject Guide to Books in Print, 1984 **An Introduction to Mathematical Relativity** José Natário, 2021-03-24 This concise textbook introduces the reader to advanced mathematical aspects of general relativity covering topics like Penrose diagrams causality theory singularity theorems the Cauchy problem for the Einstein equations the positive mass theorem and the laws of black hole thermodynamics It emerged from lecture notes originally conceived for a one semester course in Mathematical Relativity which has been taught at the Instituto Superior Técnico University of Lisbon Portugal since 2010 to Masters and Doctorate students in Mathematics and Physics Mostly self contained and mathematically rigorous this book can be appealing to graduate students in Mathematics or Physics seeking specialization in general relativity geometry or partial differential equations Prerequisites include proficiency in differential geometry and the basic principles of relativity Readers who are familiar with special relativity and have taken a course either in Riemannian geometry for students of Mathematics or in general relativity for those in Physics can benefit from this book **Choice**, 1994 **Mathematical Reviews**, 1987

New Technical Books New York Public Library, 1990 **Choice** Richard K. Gardner, Phyllis Grumm, 1976 **Scripta Mathematica**, 1967 Includes section Book reviews A Short Course in General Relativity James Foster, J. David Nightingale, 2013-02-16 Suitable as a one semester course in general relativity for senior undergraduates or beginning graduates this text clarifies the mathematical aspects of Einstein's general theory of relativity without sacrificing physical understanding Beginning with an exposition of those aspects of tensor calculus and differential geometry needed for a proper exposition of the subject the discussion turns to the space time of general relativity and to geodesic motion comparisons and contrasts with Newton's theory being drawn where appropriate A brief consideration of the field equations is followed by a discussion of physics in the vicinity of massive objects including an elementary treatment of black holes The book concludes with brief introductory chapters on gravitational radiation and cosmology and includes an appendix that reviews the special theory of relativity In preparing this new edition the authors have completely rewritten chapters to make the material readily accessible to physics students while many examples exercises and problems help guide the students through the theory

The Geometry of Spacetime James J. Callahan, 2000 Hermann Minkowski recast special relativity as essentially a new

geometric structure for spacetime This book looks at the ideas of both Einstein and Minkowski and then introduces the theory of frames surfaces and intrinsic geometry developing the main implications of Einstein's general relativity theory

The Geometry of Special Relativity - a Concise Course Norbert Dragon, 2012-08-01 In this concise primer it is shown that with simple diagrams the phenomena of time dilatation length contraction and Lorentz transformations can be deduced from the fact that in a vacuum one cannot distinguish physically straight and uniform motion from rest and that the speed of light does not depend on the speed of either the source or the observer The text proceeds to derive the important results of relativistic physics and to resolve its apparent paradoxes A short introduction into the covariant formulation of electrodynamics is also given This publication addresses in particular students of physics and mathematics in their final undergraduate year Scientific and Technical Books and Serials in Print, 1984 **Introduction to General Relativity**

Cosimo Bambi, 2018-06-18 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

A Mathematical Introduction To General Relativity Amol Sasane, 2021-08-10 The book aims to give a mathematical presentation of the theory of general relativity that is spacetime geometry based gravitation theory to advanced undergraduate mathematics students Mathematicians will find spacetime physics presented in the definition theorem proof format familiar to them The given precise mathematical definitions of physical notions help avoiding pitfalls especially in the context of spacetime physics describing phenomena that are counter intuitive to everyday experiences In the first part the differential geometry of smooth manifolds which is needed to present the spacetime based gravitation theory is developed from scratch Here many of the illustrating examples are the Lorentzian manifolds which later serve as spacetime models This has the twofold purpose of making the physics forthcoming in the second part relatable and the mathematics learnt in the first part less dry The book uses the modern coordinate free language of semi Riemannian geometry Nevertheless to familiarise the reader with the useful tool of coordinates for computations and to bridge the gap with the physics literature the link to coordinates is made through exercises and via frequent remarks on how the two languages are related In the second part the focus is on physics covering essential material of the 20th century spacetime based view of gravity energy momentum tensor field of matter field equation spacetime examples Newtonian approximation geodesics tests of the theory black holes and cosmological models of the universe Prior knowledge of differential geometry or physics is not assumed The

book is intended for self study and the solutions to the over 200 exercises are included

A Short Course in General Relativity J. Foster, J. D. Nightingale, 1995 Suitable for a one semester course in general relativity for senior undergraduate or beginning graduate students this text clarifies the mathematical aspects of Einstein's general theory of relativity without sacrificing physical understanding The text begins with an exposition of those aspects of tensor calculus and differential geometry needed for a proper exposition of the subject The discussion then turns to the spacetime of general relativity and to geodesic motion comparisons and contrasts with Newton's theory being drawn where appropriate A brief consideration of the field equations is followed by a discussion of physics in the vicinity of massive objects including an elementary treatment of black holes Particular attention is paid to those aspects of the theory that have observational consequences The book concludes with brief introductory chapters on gravitational radiation and cosmology and includes an appendix that reviews the special theory of relativity In preparing this new edition the authors have made extensive revisions to the original text In particular the first three chapters covering coordinate systems tensors and the geometry of curved spaces have been completely rewritten to make the material readily accessible to physics students Many examples exercises and problems help guide the student through the theory

Special and General Relativity Rainer Dick, 2019-02-07 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

Lecture Notes on the General Theory of Relativity Øyvind Grøn, 2009-04-20 This book collects lectures on the general theory of relativity given by Dr yvind Gr n at the University of Oslo Norway This accessible text allows students to follow the deductions all the way throughout the book

A Student's Guide to General Relativity Norman Gray, 2019-01-10 This compact guide presents the key features of general relativity to support and supplement the presentation in mainstream more comprehensive undergraduate textbooks or as a re cap of essentials for graduate students pursuing more advanced studies It helps students plot a careful path to understanding the core ideas and basics of differential geometry as applied to general relativity without overwhelming them While the guide doesn't shy away from necessary technicalities it emphasises the essential simplicity of the main physical arguments Presuming a familiarity with special relativity with a brief account in an appendix it describes how general covariance and the equivalence principle motivate Einstein's theory of gravitation It then introduces differential geometry

and the covariant derivative as the mathematical technology which allows us to understand Einstein's equations of general relativity. The book is supported by numerous worked examples and problems and important applications of general relativity are described in an appendix.

Mathematics of Relativity George Yuri Rainich, 2014-08-20 Concise treatment based on ideas of Einstein and Minkowski geared toward advanced undergraduates and graduate students of physics. Topics include old physics, new geometry, special relativity, curved space, and general relativity. 1950 edition.

Solved Problems and Systematic Introduction to Special Relativity Michael Tsamparlis, 2024-05-01 In most undergraduate physics classes, Special Relativity is taught from a simplistic point of view using Newtonian concepts rather than the relativistic way of thinking. This results in students often finding it difficult to understand properly the new approach, new ideas, and consequently to solve relativistic problems. Furthermore, a number of books treat the theory using advanced mathematics which is not necessary for the first approach to the theory. This book is intended to serve two roles: a) To treat a student in a systematic, constructive way to the basic structure of the theory, and b) To provide a large number of solved, in detail, problems in the kinematics and dynamics of Special Relativity. Concerning the first aim, the book introduces the basics of four-dimensional mathematics, i.e., Lorentz metric, relativistic tensors, and prepares through working examples the transition to General Relativity, which requires, besides the relativistic concepts, the use of Differential Geometry and tensor analysis. The presentation is concise and does not replace a book on Special Relativity. Concerning the second intention, the large number of problems provides the necessary material which can be used in order to familiarize the student with the relativistic world. These problems can be used in the class by the teachers either as working examples or as problem sheets. It will be our pleasure if the book will be useful to both students and teachers.

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