



The Mathematical Theory of Special and General Relativity

Ashok N Katti

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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.

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