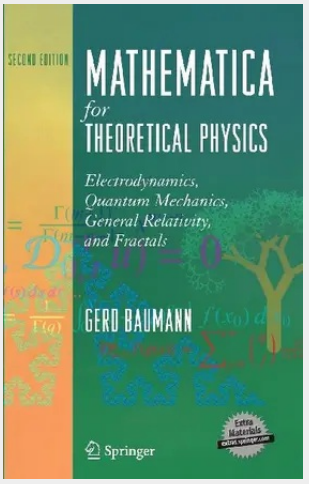
Baumann

Mathematica for Theoretical Physics

Electrodynamics, Quantum Mechanics, General Relativity, and Fractals



As physicists, mathematicians or engineers, we are all involved with mathematical calculations in our everyday work. Most of the laborious, complicated, and time-consuming calculations have to be done over and over again if we want to check the validity of our assumptions and derive new phenomena from changing models. Even in the age of computers, we often use paper and pencil to do our calculations. However, computer programs like Mathematica have revolutionized our working methods. Mathematica not only supports popular numerical calculations but also enables us to do exact analytical calculations by computer. Once we know the analytical representations of physical phenomena, we are able to use Mathematica to create graphical representations of these relations. Days of calculations by hand have shrunk to minutes by using Mathematica. Results can be verified within a few seconds, a task that took hours if not days in the past. The present text uses Mathematica as a tool to discuss andto solve examples from physics. The intention of this book is to demonstrate the usefulness of Mathematica in everyday applications. We will not give a complete description of its syntax but demonstrate by examples the use of its language. In particular, we show how this modern tool is used to solve classical problems. viii Preface This second edition of Mathematica in Theoretical Physics seeks to prevent the objectives and emphasis of the previous edition.

Mathematica for Theoretical Physics: Electrodynamics, Quantum Mechanics, General Relativity, and FractalsThis second edition of Baumann's Mathematica® in Theoretical Physics shows readers how to solve physical problems and deal with their underlying theoretical concepts while using Mathematica® to derive numeric and symbolic solutions. Each example and calculation can be evaluated by the reader, and the reader can change the example calculations and adopt the given code to related or similar problems. The second edition has been completely revised and expanded into two volumes: The first volume covers classical mechanics and nonlinear dynamics. Both topics are the basis of a regular mechanics course. The second volume covers electrodynamics, quantum mechanics, relativity, and fractals and fractional calculus. New examples have been added and the representation has been reworked to provide a more interactive problem-solving presentation. This book can be used as a textbook or as a reference work, by students and researchers alike. A brief glossary of terms and functions is contained in the appendices.The examples given in the text can also be interactively used and changed for the reader's purposes.The Author, Gerd Baumann, is affiliated with the Mathematical Physics Division of the University of Ulm, Germany, where he is professor. He is the author of Symmetry Analysis of Differential Equations with Mathematica®. Dr. Baumann has given numerous invited talks at universities and industry alike. He regularly hosts seminars and lectures on symbolic computing at the University of Ulm and at TECHNISCHE UNIVERSITÄT MÜNCHEN (TUM), Munich.

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