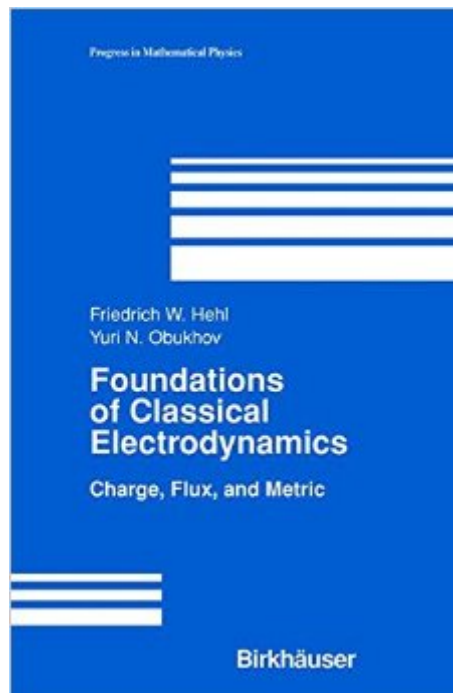


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# Foundations Of Classical Electrodynamics (Progress In Mathematical Physics)



## Synopsis

In this book we display the fundamental structure underlying classical electrodynamics, i. e. , the phenomenological theory of electric and magnetic effects. The book can be used as a textbook for an advanced course in theoretical electrodynamics for physics and mathematics students and, perhaps, for some highly motivated electrical engineering students. We expect from our readers that they know elementary electrodynamics in the conventional (1 + 3)-dimensional form including Maxwell's equations. Moreover, they should be familiar with linear algebra and elementary analysis, including vector analysis. Some knowledge of differential geometry would help. Our approach rests on the metric-free integral formulation of the conservation laws of electrodynamics in the tradition of F. Kottler (1922), E. Cartan (1923), and D. van Dantzig (1934), and we stress, in particular, the axiomatic point of view. In this manner we are led to an understanding of why the Maxwell equations have their specific form. We hope that our book can be seen in the classical tradition of the book by E. J. Post (1962) on the Formal Structure of Electromagnetism and of the chapter "Charge and Magnetic Flux" of the encyclopedia article on classical field theories by C. Truesdell and R. A. Toupin (1960), including R. A. Toupin's Bressanone lectures (1965); for the exact references see the end of the introduction on page 11. .

## Book Information

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The differential geometric method has been one of the most fundamental tools for theoretical physicists since its first introduction into special relativity (general relativity) by Albert Einstein in 1905

(1915). Later it has been applied to many research areas, such as fluid mechanics, elastomechanics, thermodynamics, solidstate physics, optics, electromagnetism, quantum field theory, etc. As a distinctive feature of traditional classical electrodynamics, this book rests on the metric-free integral formulation of the conservation laws of electrodynamics as represented by exterior differential forms. Therefore the book will be of great interest to graduate students and researchers in mathematics and theoretical physics who work in field theory and general relativity. The book consists of five parts; a short list of references and an author and a subject index are included. Every part ends with a list of references. The authors begin in Part A, as an introductory section, with an elementary presentation of exterior differential forms. The necessary geometric concepts, needed to formulate classical electrodynamics and gravitational theory in the language of differential forms, are explained in Part A and in Part C, too. The axioms of classical electrodynamics, the integral formulations of electric charge and magnetic flux conservation, are presented in Part B. Subsequently, the linear connection and the metric are introduced in Part C.

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