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Methods for the design and development of improved structures, materials and processes. The modern design cycle is characterized by the interaction between various disciplines and a strong shift to computer-based approaches where only a few experiments are conducted for verification purposes. A major driver for

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this development is the increased demand for cost reduction, which is also linked to environmental demands. In the transportation industry (e.g. automotive or aerospace), the demand for higher fuel efficiency is related to reduced operational costs and less environmental damage. One way to fulfil such requirements is lighter

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structures and/or improved processes for energy conversion. Another emerging area is the interaction of classical engineering with the health and medical sector.

There is a resurgence of applications in which the calculus of variations has direct relevance. In addition to application to

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solid mechanics and dynamics, it is now being applied in a variety of numerical methods, numerical grid generation, modern physics, various optimization settings and fluid dynamics. Many applications, such as nonlinear optimal control theory applied to continuous systems, have only recently become

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tractable computationally, with the advent of advanced algorithms and large computer systems. This book reflects the strong connection between calculus of variations and the applications for which variational methods form the fundamental foundation. The mathematical fundamentals of calculus of variations (at

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Methods necessary to pursue applications) is rather compact and is contained in a single chapter of the book. The majority of the text consists of applications of variational calculus for a variety of fields.

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approaches to classical mechanics were proposed during the 17th - 18th centuries. Newton developed his vectorial formulation that uses time-dependent differential equations of motion to relate vector observables like force and rate of change of momentum. Euler, Lagrange, Hamilton, and Jacobi, developed powerful

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alternative variational formulations based on the assumption that nature follows the principle of least action. These variational formulations now play a pivotal role in science and engineering. This book introduces variational principles and their application to classical mechanics. The relative merits of the intuitive Newtonian

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Methods Applied to the following topics: (1) Systems subject to initial boundary conditions (2) The hierarchy of related formulations based on action, Lagrangian, Hamiltonian, and equations of motion, to systems that involve symmetries. (3) Non-conservative systems. (4) Variable-mass systems. (5)

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The General Theory of Relativity. Douglas Cline is a Professor of Physics in the Department of Physics and Astronomy, University of Rochester, Rochester, New York.

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The investigation of scattering phenomena is a major theme of modern physics. A scattered particle provides a dynamical probe of the target system. The practical problem of interest here is the scattering of a low energy electron by an N-electron atom. It has been difficult in this area of study to achieve theoretical results that are

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even qualitatively correct, yet quantitative accuracy is often needed as an adjunct to experiment. The present book describes a quantitative theoretical method, or class of methods, that has been applied effectively to this problem. Quantum mechanical theory relevant to the scattering of an electron by an N-electron atom, which

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may gain or lose energy in the process, is summarized in Chapter 1. The variational theory itself is presented in Chapter 2, both as currently used and in forms that may facilitate future applications. The theory of multichannel resonance and threshold effects, which provide a rich structure to observed electron-atom

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scattering data, is presented in Chapter 3. Practical details of the computational implementation of the variational theory are given in Chapter 4. Chapters 5 and 6 summarize recent applications of the variational theory to problems of experimental interest, with many examples of the successful interpretation of complex

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structural features observed in scattering experiments, and of the quantitative prediction of details of electron-atom scattering phenomena.

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