J. T. Oden, J. N. Reddy

Variational Methods in Theoretical Mechanics

This textbook for graduate students of mathematics and engineer-
ing science covers the essential features of modern variational
theory and demonstrates how this theory can be used to produce a
unified theory of theoretical mechanics. The numerous revisions in
this edition include not only corrections but also updates and dele-
tions of certain sections.
By first laying down a broad mathematical basis for variational the-
ory in terms of properties of functionals defined on Banach spaces
and their differentials, the authors are able to construct a general
theory for variational methods in theoretical mechanics. A com-
plete account of the theory of dual and complementary variational
principles of mechanics is developed which includes a number of
new principles. Applications of the general theory to a variety of
areas are given, including viscoelasticity, nonlinear elasticity, plastic
flow, elastoplasticity, heat transfer, magnetohydrodynamics, and
non-Newtonian fluids. A chapter on monotone operators and varia-
tional inequalities is also included which contains certain results on
existence theory for some of the variational equations of mechan-
ics. The final chapter deals with variational methods of approxima-
tion and includes a summary of recent work on the theory of finite
elements.

Contents: Introduction. – Mathematical Foundations of Classical
Variational Theory. – Mechanics of Continua – A Brief Review.
Complementary and Dual Variational Principles in Mechanics. -
Variational Principles in Continuum Mechanics. – Variational
Boundary-Value Problems, Monotone Operators, and Variational
Inequalities. – Variational Methods of Approximation. – Refer-
ences.

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