Le, Khanh Chau; Nguyen, Lu Trong Khiem
Energy methods in dynamics. 2nd extended and corrected ed. (English) [Zbl 1303.70001]

For the review of the first edition see (2011; Zbl 1243.74001).

This textbook is addressed to teachers and students of mechanical and civil engineering. The emphasis is put on constructive methods of solution and not on rigorous mathematical proofs of convergence. Various numerical approximate solutions are given and compared with exact solutions to demonstrate the validity of the methods used. To help the reader to become more proficient, each chapter ends with exercises some of which can be solved effectively by using Mathematica. Vibrations and waves dominate this book, and the examples given allow to understand the mechanisms of vibrations and waves in order to control them in an optimal way.

Vibrations and waves are governed by nonlinear and sometimes linear differential equations which require complicated mathematical methods for their analyses. The main goal of this textbook is to help readers to acquire both a good grasp of the first principles from which the governing equations can be derived, and the adequate mathematical methods for their solving. The cornerstone is an intensive use of Hamilton's variational principle and its generalizations for deriving the governing equations of conservative and dissipative mechanical systems. Also very interesting is the direct variational asymptotic analysis of the energy and dissipation for the solutions of these equations.

Among other things, the authors discuss oscillators with one and many degrees of freedom, the continuous oscillators, strings, beams, membranes and plates. The book also considers eigenvalue problems in infinite-dimensional spaces, linear waves propagating in continuous media, autonomous systems with one degree of freedom, phase portraits, non-autonomous systems, Lindstedt-Poincaré and Bogolyubov-Mitropolskij methods, Poincaré maps, nonlinear wave propagation, and the inverse scattering transform.

The solutions to all exercises are included.

Reviewer: Vasile Marinca (Timişoara)

MSC:
70-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mechanics of particles and systems
74-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mechanics of deformable solids
74Jxx Waves in solid mechanics
70Kxx Nonlinear dynamics in mechanics
70H25 Hamilton’s principle
74H45 Vibrations in dynamical problems in solid mechanics
70G75 Variational methods for problems in mechanics

Keywords:
wave; variational-asymptotic method; Laplace transform; linear vibration; nonlinear vibration; Hamilton principle

Software:
Mathematica

Full Text: DOI