Introduction to Hamiltonian fluid dynamics and stability theory (Monographs and Surveys in Pure and Applied Mathematics, Chapman & Hall/CRC, 2000), 274 pp., ISBN 1-58488-0-236

A review by M. Triantafyllou (Department of Ocean Engineering, MIT)

In six chapters (an introduction followed by five technical chapters), this book outlines the Hamiltonian formulation to problems in fluid mechanics.

Chapter 2 is a lucid presentation of the basic developments of the theory for finite-dimensional systems, including formulation of the linear and nonlinear stability problems. The nonlinear pendulum is used to introduce the concepts and provide easy-to-understand application of the developments. Chapter 3 extends the concepts to partial differential equations, using the two two-dimensional Euler equations to illustrate the developments. Chapter 4 studies the linear and nonlinear stability of steady solutions of the Euler equations. Rayleigh's inflection point theorem and its nonlinear extension are discussed, among other examples.

Chapter 5 treats a generalization of the two-dimensional equations in an attempt to include phenomena observed in three-dimensional flows, using the Charney-Hasegawa-Mima equation. The examples of Chapter 4 are re-visited in great detail, including steadily traveling solutions (Rossby wave, modon). Finally, Chapter 6 studies the Korteweg de Vries equation as a model of weakly dispersive and nonlinear waves. Linear and nonlinear stability is treated.

A limited number of exercises are provided as well as a selected bibliography.

In the introduction it is stated that the book is written as a one-semester course for the advanced senior/first-year graduate student who has been exposed to introductory fluid mechanics, hydrodynamic stability, Hamiltonian mechanics, and variational calculus. If one has the desire to invest the time to get up to speed in the Hamiltonian formulation for fluid mechanics, *Introduction to Hamiltonian Dynamics and Stability Theory* is a very rewarding book, written with great attention to detail and suitable for learning new material. The price of $US89.95, although not small, is reasonable enough for the individual researcher, in addition to the libraries.