

Book Review

“Fluid Mechanics: A Short Course for Physicists”, by Gregory Falkovich, Cambridge University Press, 2011; ISBN-10: 1107005752, ISBN-13: 978-1107005754, USD: 60.00

SHREYAS MANDRE¹

The book is an elegant introduction to fluid mechanics targeted towards advanced undergraduate and beginning graduate students in physics, but is highly recommended for all scientists interested in fluid mechanics. There are a myriad of books written on fluid mechanics by engineers and mathematicians, but versions which communicate to physicists are few. This book is one of those few. The author has hand-picked the topics for discussion in the book, including potential flow, D’Alembert’s paradox, Stokes flow, instabilities and turbulence, compressible flows and waves. The author not only communicates well the intricate fundamental concepts, explanations of common observations and paradoxes in these topics, but also makes it appear so effortless that it leaves the reader wishing for a similar treatment of all the topics not included.

The book appears to start off similar to other traditional treatments with flow kinematics, hydrostatics and steady flow in the first chapter, but in fact it very early on shows signs of its flavors. Very briefly and aptly the author connects the phenomenon of thermal wind to hydrostatic gradient of pressure. The subtle issue of the distinction between the flow of a fluid with zero viscosity and vanishingly small viscosity is tackled next and the author identifies the enormous difference between the two due to the symmetry breaking role of viscosity. The second chapter is

on unsteady flow, especially flow instabilities and turbulence. The third and last chapter is on water waves where the author considers the (not so surprising) analogy between nonlinear Schrodinger equation and dispersive interfacial waves.

On one hand the book reads like poetry, on the other, rigorous proofs are interspersed throughout the book. Examples of such topics include, but are not limited to, the vanishing of the drag on a body in inviscid potential flow, the energy spectrum in turbulent flow and the nonlinear interaction of water waves. An advanced concept like Hamiltonian mechanics of continuum is used in some of the treatment, while analogies with other branches of physics are extensively used to motivate and explain concepts from fluid mechanics (although historically these concepts from mechanics inspired many of the analogous concepts in the other fields of physics). For example, the conservation of vorticity in an ideal fluid is compared with the conservation of magnetic field in an ideal conductor. The dispersion relation for water waves and its consequences are motivated by using the Schrodinger equation from quantum mechanics. The discussion is also garnished with quotes by famous people and pieces of historical information imparting to the book a language that feels lighter than some of the other treatises on the subject, and thus provide a lower threshold for entry by beginner physicists. Reader outside the physics department unfamiliar with a contemporary physics syllabus may also be introduced to some of the basic concepts of physics (Hamiltonian mechanics, analogies with quantum mechanics, electromagnetism, etc.) and treat this book as a jumping board to an advanced treatment of those topics.

¹ School of Engineering, Brown University, 182 Hope Street, Providence, RI, USA. E-mail: shreyas_mandre@brown.edu

The author shines as a master of fluid mechanics marrying eloquence, brevity and depth in this beautiful introductory treatment of the subject. While the primary target for the book are advanced physics undergraduate and beginning graduate students,

reading this book is highly recommended for all scientists interested in fluid mechanics. Every reader can take away something from reading this (it is a tour de force).