

Bibliographic Reference: Flytzanis, N. (2015). Introduction to fluid mechanics [Undergraduate textbook]. Kallipos, Open Academic Editions. http://dx.doi.org/10.57713/kallipos-503

Abstract

This course has been given for a number of years at the graduate level including elasticity. It was subsequently established as an undergraduate course in the hydrodynamics department. Students who took it continue on to graduate school and several are pursuing related specialties. It is aimed mainly at students of physics and mathematics and differs from similar books (for mathematicians and engineers) in that it emphasizes physical understanding. Its core is the basic principles of conservation (mass, momentum, energy, etc.) expressed in terms of the field concept. The operators of differential calculus are introduced and related to physical quantities of flow. Indeed, the connection with other fields, e.g. electromagnetism, acts very positively and bidirectionally. The first chapters use the tools of vector calculus familiar to fourth-year students, so that the basic laws are developed without mathematical complexity. The concept of tensors is introduced

before the chapter on viscous flow, where they are essential, so the student is already familiar with the philosophy, the description of the field, and the basic laws expressed for microscopic and macroscopic systems. Several examples of creeping viscous flow and a review of energy follow. An important chapter is dimensional analysis, a tool essential in approaches to hydrodynamics. Particular emphasis is given to surface waves, where the restoring force is gravity. Much of the anisodic flow refers to incompressible and turbulent flow, and therefore we have a chapter on the determination of the velocity field from the vorticity field, where the dynamic interaction of vortices is also studied. We also add a chapter on compressible flow and convection currents, as well as hydrodynamic instabilities. In the latter the emphasis is on a brief introduction to the concept of stability and on understanding the physical role of omitted terms leading to instability.



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