

1. Record Nr.	UNINA9910781711103321
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Titolo	Fluid mechanics : a short course for physicists // Gregory Falkovich [[electronic resource]]
Pubbl/distr/stampa	Cambridge : , : Cambridge University Press, , 2011
ISBN	1-107-22138-2 1-139-23508-7 1-283-29858-9 9786613298584 1-139-12335-1 0-511-79435-5 1-139-11760-2 1-139-11107-8 1-139-12826-4 1-139-11324-0 1-139-11543-X
Descrizione fisica	1 online resource (xii, 167 pages) : digital, PDF file(s)
Disciplina	532
Soggetti	Fluid mechanics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Title from publisher's bibliographic system (viewed on 05 Oct 2015).
Nota di bibliografia	Includes bibliographical references (p. 159-165) and index.
Nota di contenuto	Cover; Title; Copyright; Contents; Preface; Prologue; 1 Basic equations and steady flows; 1.1 Definitions and basic equations; 1.1.1 Definitions; 1.1.2 Equations of motion for an ideal fluid; 1.1.3 Hydrostatics; 1.1.4 Isentropic motion; 1.2 Conservation laws and potential flows; 1.2.1 Kinematics; 1.2.2 Kelvin's theorem; 1.2.3 Energy and momentum fluxes; 1.2.4 Irrotational and incompressible flows; 1.3 Flow past a body; 1.3.1 Incompressible potential flow past a body; 1.3.2 Moving sphere; 1.3.3 Moving body of an arbitrary shape; 1.3.4 Quasi-momentum and induced mass; 1.4 Viscosity; 1.4.1 Reversibility paradox; 1.4.2 Viscous stress tensor; 1.4.3 Navier--Stokes equation; 1.4.4 Law of similarity; 1.5 Stokes flow and the wake; 1.5.1 Slow motion; 1.5.2 The boundary layer and the separation

phenomenon; 1.5.3 Flow transformations; 1.5.4 Drag and lift with a wake; Exercises; 2 Unsteady flows; 2.1 Instabilities; 2.1.1 Kelvin--Helmholtz instability; 2.1.2 Energetic estimate of the stability threshold; 2.1.3 Landau's law; 2.2 Turbulence; 2.2.1 Cascade; 2.2.2 Turbulent river and wake; 2.3 Acoustics; 2.3.1 Sound; 2.3.2 Riemann wave; 2.3.3 Burgers equation; 2.3.4 Acoustic turbulence; 2.3.5 Mach number Exercises; 3 Dispersive waves; 3.1 Linear waves; 3.1.1 Surface gravity waves; 3.1.2 Viscous dissipation; 3.1.3 Capillary waves; 3.1.4 Phase and group velocity; 3.2 Weakly non-linear waves; 3.2.1 Hamiltonian description; 3.2.2 Hamiltonian normal forms; 3.2.3 Wave instabilities; 3.3 Non-linear Schrodinger equation (NSE); 3.3.1 Derivation of NSE; 3.3.2 Modulational instability; 3.3.3 Soliton, collapse and turbulence; 3.4 Korteweg--de-Vries (KdV) equation; 3.4.1 Waves in shallow water; 3.4.2 The KdV equation and the soliton; 3.4.3 Inverse scattering transform; Exercises
4 Solutions to exercises Chapter 1; Chapter 2; Chapter 3; Epilogue; Notes; References; Index

Sommario/riassunto

The multidisciplinary field of fluid mechanics is one of the most actively developing fields of physics, mathematics and engineering. In this book, the fundamental ideas of fluid mechanics are presented from a physics perspective. Using examples taken from everyday life, from hydraulic jumps in a kitchen sink to Kelvin-Helmholtz instabilities in clouds, the book provides readers with a better understanding of the world around them. It teaches the art of fluid-mechanical estimates and shows how the ideas and methods developed to study the mechanics of fluids are used to analyze other systems with many degrees of freedom in statistical physics and field theory. Aimed at undergraduate and graduate students, the book assumes no prior knowledge of the subject and only a basic understanding of vector calculus and analysis. It contains 32 exercises of varying difficulties, from simple estimates to elaborate calculations, with detailed solutions to help readers understand fluid mechanics.
