



# Introduction to Theoretical and Computational Fluid Dynamics

*By Constantine Pozrikidis*

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## **Introduction to Theoretical and Computational Fluid Dynamics** By Constantine Pozrikidis

This book discusses the fundamental principles and equations governing the motion of incompressible Newtonian fluids, and simultaneously introduces analytical and numerical methods for solving a broad range of pertinent problems. Topics include an in-depth discussion of kinematics, elements of differential geometry of lines and surfaces, vortex dynamics, properties and computation of interfacial shapes in hydrostatics, exact solutions, flow at low Reynolds numbers, interfacial flows, hydrodynamic stability, boundary-layer analysis, vortex motion, boundary-integral methods for potential and Stokes flow, principles of computational fluid dynamics (CFD), and finite-difference methods for Navier-Stokes flow.

The discourse includes classical and original topics, as well as derivations accompanied by solved and unsolved problems that illustrate the theoretical results and explain the implementation of the numerical methods. Appendices provide a wealth of information and establish the necessary mathematical and numerical framework.

A unique and comprehensive synthesis of the essential aspects of the discipline, this volume serves as an ideal textbook in several graduate courses on theoretical and computational fluid dynamics, applied mathematics, and scientific computing. The material is an indispensable resource for professionals and researchers in various fields of science, chemical, mechanical, biomechanical, civil and aerospace engineering.

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### **Editorial Review**

#### **Review**

Professor Pozrikidis should be congratulated on producing a textbook that not only fills a clear pedagogical need, but is written with unusual care and clarity. I cannot emphasise enough that this textbook deserves to be on the shelf of any teacher or student of fluid mechanics. Andrew Resnick, Cleveland State University, Contemporary Science

#### **From the Back Cover**

Introduction to Theoretical and Computational Fluid Dynamics is the first textbook to combine theoretical and computational aspects of fluid dynamics in a unified and comprehensive treatment. The theoretical developments are carried into the realm of numerical computation, and the numerical procedures are developed from first principles. A unique synthesis of the theoretical and computational aspects of its field, Introduction to Theoretical and Computational Fluid Dynamics serves as an ideal text and reference source for advanced undergraduate students, graduate students, and researchers in the various fields of science and engineering, including mechanical, aeronautical, and chemical engineering, applied mathematics, physics, and computational science. It assumes no prior experience in computational fluid dynamics, and provides references for specialized topics. Each section is followed by theoretical and computer problems that allow the reader to acquire hands-on experience and simultaneously develop insights into the physics of a variety of flows.

#### **About the Author**

C. Pozrikidis has held positions as Professor of Fluid Mechanics and Chemical Engineering. He is well known for his contributions in fluid mechanics and biomechanics, applied mathematics and scientific computing. He has published numerous research papers and is the author of eight books and the editor of two contributed volumes.

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