

Preface of English Edition

Fluid mechanics is a still growing subject, due to its wide application in engineering, science and medicine. This wide interest makes it necessary to have a book available that provides an overall introduction into the subject and covers, at the same time, many of the phenomena that fluid flows show for different boundary conditions. The present book has been written with this aim in mind. It gives an overview of fluid flows that occur in our natural and technical environment. The mathematical and physical background is provided as a sound basis to treat fluid flows. Tensor notation is used, and it is explained as being the best way to express the basic laws that govern fluid motions, i.e. the continuity, the momentum and the energy equations. These equations are derived in the book in a generally applicable manner, taking basic kinematics knowledge of fluid motion into account. Particular attention is given to the derivations of the molecular transport terms for momentum and heat. In this way, the generally formulated momentum equations are turned into the well-known Navier–Stokes equations. These equations are then applied, in a relatively systematic manner, to provide introductions into fields such as hydro- and aerostatics, the theory of similarity and the treatment of engineering flow problems, using the integral form of the basic equations. Potential flows are treated in an introductory way and so are wave motions that occur in fluid flows. The fundamentals of gas dynamics are covered, and the treatment of steady and unsteady viscous flows is described. Low and high Reynolds number flows are treated when they are laminar, but their transition to turbulence is also covered. Particular attention is given to flows that are turbulent, due to their importance in many technical applications. Their statistical treatment receives particular attention, and an introduction into the basics of turbulence modeling is provided. Together with the treatment of numerical methods, the present book provides the reader with a good foundation to understand the wide field of modern fluid mechanics. In the final sections, the treatment of flows with heat transfer is touched upon, and an introduction into fluid-flow measuring techniques is given.

On the above basis, the present book provides, in a systematic manner, introductions to important “subfields of fluid mechanics”, such as wave motions, gas dynamics, viscous laminar flows, turbulence, heat transfer, etc. After readers have familiarized themselves with these subjects, they will find it easy to read more advanced and specialized books on each of the treated specialized fields. They will also be prepared to read the vast number of publications available in the literature, documenting the high activity in fluid-flow research that is still taking place these days. Hence the present book is a good introduction into fluid mechanics as a whole, rather than into one of its many subfields.

The present book is a translation of a German edition entitled “Grundlagen der Strömungsmechanik: Eine Einführung in die Theorie der Strömungen von Fluiden”. The translation was carried out with the support of Ms. Inge Arnold of Saarbrücken, Germany. Her efforts to publish this book are greatly appreciated. The final proof-reading was carried out by Mr. Phil Weston of Folkestone in England. The author is grateful to Mr. Nishanth Dongari and Mr. Dominik Haspel for all their efforts in finalizing the book. Very supportive help was received in proof-reading different chapters of the book. Especially, the author would like to thank Dr.-Ing. Michael Breuer, Dr. Stefan Becker and Prof. Ashutosh Sharma for reading particular chapters. The finalization of the book was supported by Susanne Braun and Johanna Grasser. Many students at the University of Erlangen-Nürnberg made useful suggestions for corrections and improvements and contributed in this way to the completion of the English version of this book. Last but not least, many thanks need to be given to Ms. Isolina Paulus and Mr. Franz Kaschak. Without their support, the present book would have not been finalized. The author hopes that all these efforts were worthwhile, yielding a book that will find its way into teaching advanced fluid mechanics in engineering and natural science courses at universities.

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