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Handbook of Mathematical Fluid Dynamics Introduction to Mathematical Fluid Dynamics A Mathematical Introduction to Fluid Mechanics Introduction to Mathematical Fluid Dynamics Mathematical Aspects of Fluid Mechanics New Trends and Results in Mathematical Description of Fluid Flows Mathematical Fluid Mechanics Recent Developments of Mathematical Fluid Mechanics Vectors, Tensors and the Basic Equations of Fluid Mechanics Interfacial Fluid Mechanics Introduction to Theoretical and Mathematical Fluid Dynamics Fundamental Directions in Mathematical Fluid Mechanics Mathematical Topics in Fluid Mechanics Mathematical Fluid Mechanics Elementary Fluid Dynamics Topics in Mathematical Fluid Mechanics Fluid Dynamics Recent Developments of Mathematical Fluid Mechanics Mathematical Theory in Fluid Mechanics Ocular Fluid Dynamics Mathematical Theory of Compressible Fluid Flow Fluid Mechanics Numerical Simulation in Fluid Dynamics The Fluid Dynamics of Cell Motility Fundamentals of Two-Fluid Dynamics Fluid Dynamics of Viscoelastic Liquids Observability and Mathematics An Informal Introduction to Theoretical Fluid Mechanics Handbook of Mathematical Analysis in Mechanics of Viscous Fluids Lectures on Fluid Mechanics Foundations of Fluid Dynamics Contributions to Current Challenges in Mathematical Fluid Mechanics A Mathematical Introduction to Fluid Mechanics Physical Fluid Dynamics An Introduction to Theoretical Fluid Mechanics Advances in Mathematical Fluid Mechanics Computational Fluid Dynamics Engineering Mathematics I Introductory Incompressible Fluid Mechanics Fluid-Structure Interaction and Biomedical Applications

Suitable for advanced undergraduate and graduate students, this text covers general theorems, conservation equations, waves, shocks, and nonisentropic flows, with emphasis on the basics, both conceptual and mathematical. 1958 edition. A pedagogical review of the mathematical modelling in fluid dynamics necessary to understand the motility of most microorganisms on Earth. INTRODUCTION TO THEORETICAL AND MATHEMATICAL FLUID DYNAMICS A practical treatment of mathematical fluid dynamics In Introduction to Theoretical and Mathematical Fluid Dynamics, distinguished researcher Dr. Bhimsen K. Shivamoggi delivers a comprehensive and insightful exploration of fluid dynamics from a mathematical point of view. The book introduces readers to the mathematical study of fluid behavior and highlights areas of active research in fluid dynamics. With coverage of advances in the field over the last 15 years, this book provides in-depth examinations of theoretical and mathematical fluid dynamics with a particular focus on incompressible and compressible fluid flows. Introduction to Theoretical and Mathematical Fluid Dynamics includes practical applications and exercises to illustrate the concepts discussed within, and real-world examples are explained throughout the text. Clear and explanatory material accompanies the rigorous mathematics, making the book perfect for students seeking to learn and retain this complex subject. The book also offers: A thorough introduction to the basic concepts and equations of fluid dynamics, including an introduction to the fluid model, the equations of fluid flows, and surface tension effects Comprehensive explorations of the dynamics of incompressible fluid flows, fluid kinematics and dynamics, the complex-variable method, and three-dimensional irrotational flows Practical discussions of the dynamics of compressible fluid flows, including a review of thermodynamics, isentropic fluid flows, potential flows, and nonlinear theory of plane sound waves Ideal for graduate-level students taking courses on mathematical fluid dynamics as part of a program in mathematics, engineering, or physics, Introduction to Theoretical and Mathematical Fluid Dynamics is also an indispensable resource for practicing applied mathematicians, engineers, and physicists. Introductory text, geared toward advanced undergraduate and graduate students, applies mathematics of Cartesian and general tensors to physical field theories and demonstrates them in terms of the theory of fluid mechanics. 1962 edition. This volume brings together five contributions to mathematical fluid mechanics, a classical but still very active research field which overlaps with physics and engineering. The contributions cover not only the classical Navier-Stokes equations for an incompressible Newtonian fluid, but also generalized Newtonian fluids, fluids interacting with particles and with solids, and stochastic models. The questions addressed in the lectures range from the basic problems of existence of weak and more regular solutions, the local regularity theory and analysis of potential singularities, qualitative and quantitative results about the behavior in special cases, asymptotic behavior, statistical properties and ergodicity. This is the fourth volume in a series of survey articles covering many aspects of mathematical fluid dynamics, a vital source of open mathematical problems and exciting physics. An introduction to CFD fundamentals and using commercial CFD software to solve engineering problems, designed for the wide variety of engineering students new to CFD, and for practicing engineers learning CFD for the first time. Combining an appropriate level of mathematical background, worked examples, computer screen shots, and step by step processes, this book walks the reader through modeling and computing, as well as interpreting CFD results. The first book in the field aimed at CFD users rather than developers. New to this edition: A more comprehensive coverage of CFD techniques including discretisation via finite element and spectral element as well as finite difference and finite volume methods and multigrid method. Coverage of different approaches to CFD grid generation in order to closely match how CFD meshing is being used in industry. Additional coverage of high-pressure fluid dynamics and meshless approach to provide a broader overview of the application areas where CFD can be used. 20% new content Mathematical modeling and numerical simulation in fluid mechanics are topics of great importance both in theory and technical applications. The present book attempts to describe the current status in various areas of research. The 10 chapters, mostly survey articles, are written by internationally renowned specialists and offer a range of approaches to and views of the essential questions and problems. In particular, the theories of incompressible and compressible Navier-Stokes equations are considered, as well as stability theory and numerical methods in fluid mechanics. Although the book is primarily written for researchers in the field, it will also serve as a valuable source of information to graduate students. An informal first introduction to theoretical fluid mechanics for undergraduate mathematicians or engineers. The rigorous mathematical theory of the equations of fluid dynamics has been a focus of intense activity in recent years. This volume is the product of a workshop held at the University of Warwick to consolidate, survey and further advance the subject. The Navier–Stokes equations feature prominently: the reader will find new results concerning feedback stabilisation, stretching and folding, and decay in norm of solutions to these fundamental equations of fluid motion. Other topics covered include new models for turbulent energy cascade, existence and uniqueness results for complex fluids and certain interesting solutions of the SQG equation. The result is an accessible collection of survey articles and more traditional research papers that will serve both as a helpful overview for graduate students new to the area and as a useful resource for more established researchers. Structured introduction covers everything the engineer needs to know: nature of fluids, hydrostatics, differential and integral relations, dimensional analysis, viscous flows, more. Solutions to selected problems. 760 illustrations. 1985 edition. This book presents, in a methodical way, updated and comprehensive descriptions and analyses of some of the most relevant problems in the context of fluid-structure interaction (FSI). Generally speaking, FSI is among the most popular and intriguing problems in applied sciences and includes industrial as well as biological applications. Various fundamental aspects of FSI are addressed from different perspectives, with a focus on biomedical applications. More specifically, the book presents a mathematical analysis of basic questions like the well-posedness of the relevant initial and boundary value problems, as well as the modeling and the numerical simulation of a number of fundamental phenomena related to human biology. These latter research topics include blood flow in arteries and veins, blood coagulation and speech modeling. We believe that the variety of the topics discussed, along with the different approaches used to address and solve the corresponding problems, will help readers to develop a more holistic view of the latest findings on the subject, and of the relevant open questions. For the same reason we expect the book to become a trusted companion for researchers from diverse disciplines, such as mathematics, physics, mathematical biology, bioengineering and medicine. Interfacial Fluid Mechanics: A Mathematical Modeling Approach provides an introduction to mathematical models of viscous flow used in rapidly developing fields of microfluidics and microscale heat transfer. The basic physical effects are first introduced in the context of simple configurations and their relative importance in typical microscale applications is discussed. Then, several configurations of importance to microfluidics, most notably thin films/droplets on substrates and confined bubbles, are discussed in detail. Topics from current research on electrokinetic phenomena, liquid flow near structured solid surfaces,evaporation/condensation, and surfactant phenomena are discussed in the later chapters. This textbook provides a clear and concise introduction to both theory and application of fluid dynamics. It has a wide scope, frequent references to experiments, and numerous exercises (with hints and answers). Mathematics has always played a key role for researches in fluid mechanics. The purpose of this handbook is to give an overview of items that are key to handling problems in fluid mechanics. Since the field of fluid mechanics is huge, it is almost impossible to cover many topics. In this handbook, we focus on mathematical analysis on viscous Newtonian fluid. The first part is devoted to mathematical analysis on incompressible fluids while part 2 is devoted to compressible fluids. This volume consists of six articles, each treating an important topic in the theory ofthe Navier-Stokes equations, at the research level. Some of the articles are mainly expository, putting together, in a unified setting, the results of recent research papers and conference lectures. Several other articles are devoted mainly to new results, but present them within a wider context and with a fuller exposition than is usual for journals. The plan to publish these articles as a book began with the lecture notes for the short courses of G.P. Galdi and R. Rannacher, given at the beginning of the International Workshop on Theoretical and Numerical Fluid Dynamics, held in Vancouver, Canada, July 27 to August 2, 1996. A renewed energy for this project came with the founding of the Journal of Mathematical Fluid Mechanics, by G.P. Galdi, J. Heywood, and R. Rannacher, in 1998. At that time it was decided that this volume should be published in association with the journal, and expanded to include articles by J. Heywood and W. Nagata, J. Heywood and M. Padula, and P. Gervasio, A. Quarteroni and F. Saleri. The original lecture notes were also revised and updated. This volume consists of four contributions that are based on a series of lectures delivered by Jens Frehse. Konstantin Pikeckas, K.R. Rajagopal and Wolf von Wahl t the Fourth Winter School in Mathematical Theory in Fluid Mechanics, held in Paseky, Czech Republic, from December 3-9, 1995. In these papers the authors present the latest research and updated surveys of relevant topics in the various areas of theoretical fluid mechanics. Specifically, Frehse and Ruzicka study the question of the existence of a regular solution to Navier-Stokes equations in five dimensions by means of weighted estimates. Pileckas surveys recent results regarding the solvability of the Stokes and Navier-Stokes system in domains with outlets at infinity. K.R. Rajagopal presents an introduction to a continuum approach to mixture theory with the emphasis on the constitutive equation, boundary conditions and moving singular surface. Finally, Kaiser and von Wahl bring new results on stability of basic flow for the Taylor-Couette problem in the small-gap limit. This volume would be indicated for those in the fields of applied mathematicians, researchers in fluid mechanics and theoretical mechanics, and mechanical engineers. This book highlights the latest advances in engineering mathematics with a main focus on the mathematical models, structures, concepts, problems and computational methods and algorithms most relevant for applications in modern technologies and engineering. In particular, it features mathematical methods and models of applied analysis, probability theory, differential equations, tensor analysis and computational modelling used in applications to important problems concerning electromagnetics, antenna technologies, fluid dynamics, material and continuum physics and financial engineering. The individual chapters cover both theory and applications, and include a wealth of figures, schemes, algorithms, tables and results of data analysis and simulation. Presenting new methods and results, reviews of cutting-edge research, and open problems for future research, they equip readers to develop new mathematical methods and concepts of their own, and to further compare and analyse the methods and results discussed.The book consists of contributed chapters covering research developed as a result of a focused international seminar series on mathematics and applied mathematics and a series of three focused international research workshops on engineering mathematics organised by the Research Environment in Mathematics and Applied Mathematics at Mälardalen University from autumn 2014 to autumn 2015: the International Workshop on Engineering Mathematics for Electromagnetics and Health Technology; the International Workshop on Engineering Mathematics, Algebra, Analysis and Electromagnetics; and the 1st Swedish-Estonian International Workshop on Engineering Mathematics, Algebra, Analysis and Applications.It serves as a source of inspiration for a broad spectrum of researchers and research students in applied mathematics, as well as in the areas of applications of mathematics considered in the book. Geared toward advanced undergraduate and graduate students in applied mathematics, engineering, and the physical sciences, this introductory text covers kinematics, momentum principle, Newtonian fluid, compressibility, and other subjects. 1971 edition. Readable and user-friendly, this high-level introduction explores the derivation of the equations of fluid motion from statistical mechanics, classical theory, and a portion of the modern mathematical theory of viscous, incompressible fluids. 1973 edition. This book gives an overview of classical topics in fluid dynamics, focusing on the kinematics and dynamics of incompressible inviscid and Newtonian viscous fluids, but also including some material on compressible flow. The topics are chosen to illustrate the mathematical methods of classical fluid dynamics. The book is intended to prepare the reader for more advanced topics of current research interest. This volume consists of five research articles, each dedicated to a significant topic in the mathematical theory of the Navier-Stokes equations, for compressible and incompressible fluids, and to related questions. All results given here are new and represent a noticeable contribution to the subject. One of the most famous predictions of the Kolmogorov theory of turbulence is the so-called Kolmogorov-obukhov five-thirds law. As is known, this law is heuristic and, to date, there is no rigorous justification. The article of A. Biryuk deals with the Cauchy problem for a multi-dimensional Burgers equation with periodic boundary conditions. Estimates in suitable norms for the corresponding solutions are derived for "large" Reynolds numbers, and their relation with the Kolmogorov-Obukhov law are discussed. Similar estimates are also obtained for the Navier-Stokes equation. In the late sixties J. L. Lions introduced a "perturbation" of the Navier Stokes equations in which he added in the linear momentum equation the hyper dissipative term (-Ll),Bu, f3 ~ 5/4, where Ll is the Laplace operator. This term is referred to as an "artificial" viscosity. Even though it is not physically moti vated, artificial viscosity has proved a useful device in numerical simulations of the Navier-Stokes equations at high Reynolds numbers. The paper of of D. Chae and J. Lee investigates the global well-posedness of a modification of the Navier Stokes equation similar to that introduced by Lions, but where now the original dissipative term -Llu is replaced by (-Ll)O:u, 0 S Ct In this translation of the German edition, the authors provide insight into the numerical simulation of fluid flow. Using a simple numerical method as an expository example, the individual steps of scientific computing are presented: the derivation of the mathematical model; the discretization of the model equations; the development of algorithms; parallelization; and visualization of the computed data. In addition to the treatment of the basic equations for modeling laminar, transient flow of viscous, incompressible fluids - the Navier-Stokes equations - the authors look at the simulation of free surface flows; energy and chemical transport; and turbulence. Readers are enabled to write their own flow simulation program from scratch. The variety of applications is shown in several simulation results, including 92 black-and-white and 18 color illustrations. After reading this book, readers should be able to understand more enhanced algorithms of computational fluid dynamics and apply their new knowledge to other scientific fields. Excellent coverage of kinematics, momentum principle, Newtonian fluid, rotating fluids, compressibility, and more. Geared toward advanced undergraduate and graduate students of mathematics and science; prerequisites include calculus and vector analysis. 1971 edition. The aim of this proceeding is addressed to present recent developments of the mathematical research on the Navier-Stokes equations, the Euler equations and other related equations. In particular, we are interested in such problems as: 1) existence, uniqueness and regularity of weak solutions2) stability and its asymptotic behavior of the rest motion and the steady state3) singularity and blow-up of weak and strong solutions4) vorticity and energy conservation5) fluid motions around the rotating axis or outside of the rotating body6) free boundary problems7) maximal regularity theorem and other abstract theorems for mathematical fluid mechanics. This book consists of six survey contributions that are focused on several open problems of theoretical fluid mechanics both for incompressible and compressible fluids. The first article "Viscous flows in Besov spaces" by M area Cannone ad dresses the problem of global existence of a uniquely defined solution to the three-dimensional Navier-Stokes equations for incompressible fluids. Among others the following topics are intensively treated in this contribution: (i) the systematic description of the spaces of initial conditions for which there exists a unique local (in time) solution or a unique global solution for small data, (ii) the existence of forward self-similar solutions, (iii) the relation of these results to Leray's weak solutions and backward self-similar solutions, (iv) the extension of the results to further nonlinear evolutionary problems. Particular attention is paid to the critical spaces that are invariant under the self-similar transform. For sufficiently small Reynolds numbers, the conditional stability in the sense of Lyapunov is also studied. The article is endowed by interesting personal and historical comments and an exhaustive bibliography that gives the reader a complete picture about available literature. The papers "The dynamical system approach to the Navier-Stokes equa tions for compressible fluids" by Eduard Feireisl, and "Asymptotic problems and compressible-incompressible limits" by Nader Masmoudi are devoted to the global (in time) properties of solutions to the Navier-Stokes equa and three tions for compressible fluids. The global (in time) analysis of two dimensional motions of compressible fluids were left open for many years. Two-fluid dynamics is a challenging subject rich in physics and prac tical applications. Many of the most interesting problems are tied to the loss of stability which is realized in preferential positioning and shaping of the interface, so that interfacial stability is a major player in this drama. Typically, solutions of equations governing the dynamics of two fluids are not uniquely determined by the boundary data and different configurations of flow are compatible with the same data. This is one reason why stability studies are important; we need to know which of the possible solutions are stable to predict what might be observed. When we started our studies in the early 1980's, it was not at all evident that stability theory could actu ally work in the hostile environment of pervasive nonuniqueness. We were pleasantly surprised, even astounded, by the extent to which it does work. There are many simple solutions, called basic flows, which are never stable, but we may always compute growth rates and determine the wavelength and frequency of the unstable mode which grows the fastest. This proce dure appears to work well even in deeply nonlinear regimes where linear theory is not strictly valid, just as Lord Rayleigh showed long ago in his calculation of the size of drops resulting from capillary-induced pinch-off of an inviscid jet. The chapters in this contributed volume showcase current theoretical approaches in the modeling of ocular fluid dynamics in health and disease. By including chapters written by experts from a variety of fields, this volume will help foster a genuinely collaborative spirit between clinical and research scientists. It vividly illustrates the advantages of clinical and experimental methods, data-driven modeling, and physically-based modeling, while also detailing the limitations of each approach. Blood, aqueous humor, vitreous humor, tear film, and cerebrospinal fluid each have a section dedicated to their anatomy and physiology, pathological conditions, imaging techniques, and mathematical modeling. Because each fluid receives a thorough analysis from experts in their respective fields, this volume stands out among the existing ophthalmology literature. Ocular Fluid Dynamics is ideal for current and future graduate students in applied mathematics and ophthalmology who wish to explore the field by investigating open questions, experimental technologies, and mathematical models. It will also be a valuable resource for researchers in mathematics, engineering, physics, computer science, chemistry, ophthalmology, and more. The aim of this proceeding is addressed to present recent developments of the mathematical research on the Navier-Stokes equations, the Euler equations and other related equations. In particular, we are interested in such problems as: 1) existence, uniqueness and regularity of weak solutions2) stability and its asymptotic behavior of the rest motion and the steady state3) singularity and blow-up of weak and strong solutions4) vorticity and energy conservation5) fluid motions around the rotating axis or outside of the rotating body6) free boundary problems7) maximal regularity theorem and other abstract theorems for mathematical fluid mechanics. This book aims to include various significant research topics of mathematical fluid mechanics having relevance or applications in engineering and applied sciences, covering the tools and techniques used for developing mathematical methods and modelling related to real-life situations. The author approaches an old classic problem - the existence of solutions of Navier-Stokes equations. The main objective is to model and derive of equation of continuity, Euler equation of fluid motion, energy flux equation, Navier-Stokes equations from the observer point of view and solve classic problem for this interpretation of fluid motion laws. If we have a piece of metal or a volume of liquid, the idea impresses itself upon us that it is divisible without limit, that any part of it, however small, would again have the same properties. But, wherever the methods of research in the physics of matter were refined sufficiently, limits to divisibility were reached that are not due to the inadequacy of our experiments but to the nature of the subject matter. Observability in mathematics were developed by the author based on denial of infinity idea. He introduces observers into arithmetic, and arithmetic becomes dependent on observers. And after that the basic mathematical parts also become dependent on observers. This approach permits to reconsider the fluid motion laws, analyze them and get solutions of classic problems. Table of Contents 1. Introduction. 2. Observability and Arithmetic. 3. Observability and Vector Algebra. 4. Observability and Mathematical Analysis (Calculus). 5. Classic Fluid Mechanics equations and Observability. 6. Observability and Thermodynamical equations. 7. Observability and equation of continuity. 8. Observability and Euler equation of motion of the fluid. 9. Observability and energy flux and moment flux equations. 10. Observability and incompressible fluids. 11. Observability and Navier-Stokes equations. 12. Observability and Relativistic Fluid Mechanics. 13. Appendix: Review of publications of the Mathematics with Observers. 14. Glossary. Bibliography Index Biography Boris Khots, DrSci, lives in Iowa, USA, Independent Researcher. Alma Mater - Moscow State Lomonosov University, Department of Mathematics and Mechanics (mech-math). Creator of Observer’s Mathematics. Participant of more than 30 Mathematical international congresses, conferences. In particular, participated with presentation at International Congresses of Mathematicians on 1998 (Germany), 2002 (China), 2006 (Spain), 2010 (India), 2014 (South Korea). More than 150 mathematical books and papers. To classify a book as 'experimental' rather than 'theoretical' or as 'pure' rather than 'applied' is liable to imply umeal distinctions. Nevertheless, some Classification is necessary to teIl the potential reader whether the book is for him. In this spirit, this book may be said to treat fluid dynamies as a branch of physics, rather than as a branch of applied mathematics or of engineering. I have often heard expressions of the need for such a book, and certainly I have feIt it in my own teaching. I have written it primariIy for students of physics and of physics-based applied science, aIthough I hope others may find it useful. The book differs from existing 'fundamental' books in placing much greater emphasis on what we know through laboratory experiments and their physical interpretation and less on the mathe matieal formalism. It differs from existing 'applied' books in that the choice of topics has been made for the insight they give into the behaviour of fluids in motion rather than for their practical importance. There are differences also from many existing books on fluid dynamics in the branches treated, reflecting to some extent shifts of interest in reeent years. In particular, geophysical and astrophysical applications have prompted important fundamental developments in topics such as conveetion, stratified flow, and the dynamics of rotating fluids. These developments have hitherto been reflected in the contents of textbooks only to a limited extent. This introduction to the mathematics of incompressible fluid mechanics and its applications keeps prerequisites to a minimum – only a background knowledge in multivariable calculus and differential equations is required. Part One covers inviscid fluid mechanics, guiding readers from the very basics of how to represent fluid flows through to the incompressible Euler equations and many real-world applications. Part Two covers viscous fluid mechanics, from the stress/rate of strain relation to deriving the incompressible Navier-Stokes equations, through to Beltrami flows, the Reynolds number, Stokes flows, lubrication theory and boundary layers. Also included is a self-contained guide on the global existence of solutions to the incompressible Navier-Stokes equations. Students can test their understanding on 100 progressively structured exercises and look beyond the scope of the text with carefully selected mini-projects. Based on the authors' extensive teaching experience, this is a valuable resource for undergraduate and graduate students across mathematics, science, and engineering. This Research Note presents several contributions and mathematical studies in fluid mechanics, namely in non-Newtonian and viscoelastic fluids and on the Navier-Stokes equations in unbounded domains. It includes review of the mathematical analysis of incompressible and compressible flows and results in magnetohydrodynamic and electrohydrodynamic stability and thermoconvective flow of Boussinesq-Stefan type. These studies, along with brief communications on a variety of related topics comprise the proceedings of a summer course held in Lisbon, Portugal in 1991. Together they provide a set of comprehensive survey and advanced introduction to problems in fluid mechanics and partial differential equations. The book presents recent results and new trends in the theory of fluid mechanics. Each of the four chapters focuses on a different problem in fluid flow accompanied by an overview of available older results. The chapters are extended lecture notes from the ESSAM school "Mathematical Aspects of Fluid Flows" held in Kácov (Czech Republic) in May/June 2017. The lectures were presented by Dominic Breit (Heriot-Watt University Edinburgh), Yann Brenier (École Polytechnique, Palaiseau), Pierre-Emmanuel Jabin (University of Maryland) and Christian Rohde (Universität Stuttgart), and cover various aspects of mathematical fluid mechanics – from Euler equations, compressible

Navier-Stokes equations and stochastic equations in fluid mechanics to equations describing two-phase flow; from the modeling and mathematical analysis of equations to numerical methods. Although the chapters feature relatively recent results, they are presented in a form accessible to PhD students in the field of mathematical fluid mechanics. In the summer of 1941 Brown University undertook a Program of Advanced Instruction and Research in Mechanics. This in fact was the precursor to the present day Division of Applied Mathematics. Certainly an outstanding feature of this program must have been the lectures in Fluid Dynamics by Professor Friedrichs and the late Professor von Mises. Their notes were prepared in mimeograph form and given a wide distribution at that time. Since their appearance these lectures have had a strong influence on teaching and research in the subject. As the reader soon learns the notes have lost none of their vitality over the years. Indeed in certain instances only in the last few years has the -field caught up with the ideas developed in the course of these lectures. Many ideas of value are still to be found in these notes and the Editors are most happy to be able to include this volume in the series. The corrections which have accumulated over the years have been incorporated, and in addition an index has been added. With these exceptions all desire to revise has been resisted. Also in this connection we are very grateful to Dr. T. H. Chong for carefully overseeing the preparation of the present manuscript. These notes are based on a one-quarter (i. e. very short) course in fluid mechanics taught in the Department of Mathematics of the University of California, Berkeley during the Spring of 1978. The goal of the course was not to provide an exhaustive account of fluid mechanics, nor to assess the engineering value of various approxima tion procedures. The goals were: (i) to present some of the basic ideas of fluid mechanics in a mathematically attractive manner (which does not mean "fully rigorous"); (ii) to present the physical back ground and motivation for some constructions which have been used in recent mathematical and numerical work on the Navier-Stokes equations and on hyperbolic systems; (iil.) 'to interest some of the students in this beautiful and difficult subject. The notes are divided into three chapters. The first chapter contains an elementary derivation of the equations; the concept of vorticity is introduced at an early stage. The second chapter contains a discussion of potential flow, vortex motion, and boundary layers. A construction of boundary layers using vortex sheets and random walks is presented; it is hoped that it helps to clarify the ideas. The third chapter contains an analysis of one-dimensional gas iv flow, from a mildly modern point of view. Weak solutions, Riemann problems, Glimm's scheme, and combustion waves are discussed. The style is informal and no attempt was made to hide the authors' biases and interests. This book is about two special topics in rheological fluid mechanics: the elasticity of liquids and asymptotic theories of constitutive models. The major emphasis of the book is on the mathematical and physical consequences of the elasticity of liquids; seventeen of twenty chapters are devoted to this. Constitutive models which are instantaneously elastic can lead to some hyperbolicity in the dynamics of flow, waves of vorticity into rest (known as shear waves), to shock waves of vorticity or velocity, to steady flows of transonic type or to short wave instabilities which lead to ill-posed problems. Other kinds of models, with small Newtonian viscosities, give rise to perturbed instantaneous elasticity, associated with smoothing of discontinuities as in gas dynamics. There is no doubt that liquids will respond like elastic solids to impulses which are very rapid compared to the time it takes for the molecular order associated with short range forces in the liquid, to relax. After this, all liquids look viscous with signals propagating by diffusion rather than by waves. For small molecules this time of relaxation is estimated as lQ-13 to 10-10 seconds depending on the fluids. Waves associated with such liquids move with speeds of 1 QS cm/s, or even faster. For engineering applications the instantaneous elasticity of these fluids is of little interest; the practical dynamics is governed by diffusion, ·say, by the Navier-Stokes equations. On the other hand, there are other liquids which are known to have much longer times of relaxation. This monograph on fluid mechanics is not only a superb and unique textbook but also an impressive piece of research. It is the only textbook that fully covers turbulence, all the way from the works of Kolmogorov to modern dynamics. A presentation of some of the basic ideas of fluid mechanics in a mathematically attractive manner. The text illustrates the physical background and motivation for some constructions used in recent mathematical and numerical work on the Navier- Stokes equations and on hyperbolic systems, so as to interest students in this at once beautiful and difficult subject. This third edition incorporates a number of updates and revisions, while retaining the spirit and scope of the original book.