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Modern Fluid Dynamics: Basic Theory and Selected ...
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Since fluid dynamics involves the study of the motion of fluid, one of the first concepts that must be understood is how physicists quantify that movement. The term that physicists use to describe the physical properties of the movement of liquid is flow. Flow describes a wide range of fluid movement, such blowing through the air, flowing through a pipe, or running along a surface.

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This work evolved primarily out of industrial demands and post-graduate expectations, because a fine knowledge base in modern fluid dynamics is important, focusing on novel application areas such as microfluidics, mixture flows, fluid-structure interaction, biofluid dynamics, thermal flows, and fluid-particle transport.

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Modern Fluid Dynamics : Basic Theory and Selected Applications in Macro- and Micro-Fluidics. This textbook covers essentials of traditional and modern fluid dynamics, i. e. , the fundamentals of and basic applications in fluid mechanics and convection heat transfer with brief ...

This textbook covers essentials of traditional and modern fluid dynamics, i. e. , the fundamentals of and basic applications in fluid mechanics and convection heat transfer with brief excursions into fluid-particle dynamics and solid mechanics. Specifically, it is suggested that the book can be used to enhance the knowledge base and skill level of engineering and physics students in macro-scale fluid mechanics (see Chaps. 1–5 and 10), followed by an int- ductory excursion into micro-scale fluid dynamics (see Chaps. 6 to 9). These ten chapters are rather self-contained, i. e. , most of the material of Chaps. 1–10 (or selectively just certain chapters) could be taught in one course, based on the students’ background. Typically, serious seniors and first-year graduate students form a receptive audience (see sample syllabus). Such as target group of students would have had prerequisites in thermodynamics, fluid mechanics and solid mechanics, where Part A would be a welcomed refresher. While introductory fluid mechanics books present the material in progressive order, i. e. , employing an inductive approach from the simple to the more difficult, the present text adopts more of a deductive approach. Indeed, understanding the derivation of the basic equations and then formulating the system-specific equations with suitable boundary conditions are two key steps for proper problem solutions.

Modern Fluid Dynamics, Second Edition provides up-to-date coverage of intermediate and advanced fluids topics. The text emphasizes fundamentals and applications, supported by worked examples and case studies. Scale analysis, non-Newtonian fluid flow, surface coating, convection heat transfer, lubrication, fluid-particle dynamics, microfluidics, entropy generation, and fluid-structure interactions are among the topics covered. Part A presents fluids principles, and prepares readers for the applications of fluid dynamics covered in Part B, which includes computer simulations and project writing. A review of the engineering math needed for fluid dynamics is included in an appendix.

Modeling and Analysis of Modern Fluids helps researchers solve physical problems observed in fluid dynamics and related fields, such as heat and mass transfer, boundary layer phenomena, and numerical heat transfer. These problems are characterized by nonlinearity and large system dimensionality, and ‘exact’ solutions are impossible to provide using the conventional mixture of theoretical and analytical analysis with purely numerical methods. To solve these complex problems, this work provides a toolkit of established and novel methods drawn from the literature across nonlinear approximation theory. It covers Padé approximation theory, embedded-parameters perturbation, Adomian decomposition, homotopy analysis, modified differential transformation, fractal theory, fractional calculus, fractional differential equations, as well as classical numerical techniques for solving nonlinear partial differential equations. In addition, 3D modeling and analysis are also covered in-depth. Systematically describes powerful approximation methods to solve nonlinear equations in fluid problems Includes novel developments in fractional order differential equations with fractal theory applied to fluids Features new methods, including Homotypy Approximation, embedded-parameter perturbation, and 3D models and analysis

This book grew out of the need to provide students with a solid introduction to modern fluid dynamics. It offers a broad grounding in the underlying principles and techniques used, with some emphasis on applications in astrophysics and planetary science. The book comprehensively covers recent developments, methods and techniques, including, for example, new ideas on transitions to turbulence (via transiently growing stable linear modes), new approaches to turbulence (which remains the enigma of fluid dynamics), and the use of asymptotic approximation methods, which can give analytical or semi-analytical results and complement fully numerical treatments. The authors also briefly discuss some important considerations to be taken into account when developing a numerical code for computer simulation of fluid flows. Although the text is populated throughout with examples and problems from the field of astrophysics and planetary science, the text is eminently suitable as a general introduction to fluid dynamics. It is assumed that the readers are mathematically equipped with a reasonable knowledge in analysis, including basics of ordinary and partial differential equations and a good command of vector calculus and linear algebra. Each chapter concludes with bibliographical notes in which the authors briefly discuss the chapter's essential literature and give recommendations for further, deeper reading. Included in each chapter are a number of problems, some of them relevant to astrophysics and planetary science. The book is written for advanced undergraduate and graduate students, but will also prove a valuable source of reference for established researchers.

Ready access to computers at an institutional and personal level has defined a new era in teaching and learning. The opportunity to extend the subject matter of traditional science and engineering disciplines into the realm of scientific computing has become not only desirable, but also necessary. Thanks to port ability and low overhead and operating costs, experimentation by numerical simulation has become a viable substitute, and occasionally the only alternative, to physical experiment at ion. The new environment has motivated the writing of texts and mono graphs with a modern perspective that incorporates numerical and com puter programming aspects as an integral part of the curriculum: meth ods, concepts, and ideas should be presented in a unified fashion that motivates and underlines the urgency of the new elements, but does not compromise the rigor of the classical approach and does not oversimplify. Interfacing fundamental concepts and practical methods of scientific computing can be done on different levels. In one approach, theory and implement at ion are kept complementary and presented in a sequential fashion. In a second approach, the coupling involves deriving compu tational methods and simulation algorithms, and translating equations into computer code instructions immediately following problem formu lations. The author of this book is a proponent of the second approach and advocates its adoption as a means of enhancing learning: interject ing methods of scientific computing into the traditional discourse offers a powerful venue for developing analytical skills and obtaining physical insight.

Fluid mechanics, the study of how fluids behave and interact under various forces and in various applied situations-whether in the liquid or gaseous state or both-is introduced and comprehensively covered in this widely adopted text. Revised and updated by Dr. David Dowling, Fluid Mechanics, Fifth Edition is suitable for both a first or second course in fluid mechanics at the graduate or advanced undergraduate level. The leading advanced general text on fluid mechanics, Fluid Mechanics, 5e includes a free copy of the DVD "Multimedia Fluid Mechanics," second edition. With the inclusion of the DVD, students can gain additional insight about fluid flows through nearly 1,000 fluids video clips, can conduct flow simulations in any of more than 20 virtual labs and simulations, and can view dozens of other new interactive demonstrations and animations, thereby enhancing their fluid mechanics learning experience. Text has been reorganized to provide a better flow from topic to topic and to consolidate portions that belong together. Changes made to the book's pedagogy accommodate the needs of students who have completed minimal prior study of fluid mechanics. More than 200 new or revised end-of-chapter problems illustrate fluid mechanical principles and draw on phenomena that can be observed in everyday life. Includes free Multimedia Fluid Mechanics 2e DVD

This festschrift in honor of Professor Budugur Lakshminarayana's 60th birthday-based on the proceedings of a symposium on Turbomachinery Fluid Dynamics and Heat Transfer held recently at The Pennsylvania State University, University Park-provides authoritative and conclusive research results as well as new insights into complex flow features found in the turbomachinery used for propulsion, power, and industrial applications. Explaining in detail compressors, heat transfer fields in turbines, computational fluid dynamics, and unsteady flows, Turbomachinery Fluid Dynamics and Heat Transfer covers: Mixing mechanisms, annulus wall boundary layers, and the flow field in transonic turbocompressors The numerical implementation of turbulence models in a computer code Secondary flows, film cooling, and thermal turbulence modeling The visualization method of modeling using liquid crystals Innovative techniques in the computational modeling of compressor and turbine flows measurement in unsteady flows as well as axial flows and compressor noise generation And much more Generously illustrated and containing key bibliographic citations, Turbomachinery Fluid Dynamics and Heat Transfer is an indispensable resource for mechanical, design, aerospace, marine, manufacturing, materials, industrial, and reliability engineers; and upper-level undergraduate and graduate students in these disciplines.

This is perhaps the first book containing biographical information of Sir James Lighthill and his major scientific contributions to the different areas of fluid mechanics, applied mathematics, aerodynamics, linear and nonlinear waves in fluids, geophysical fluid dynamics, biofluiddynamics, aeroelasticity, boundary layer theory, generalized functions, and Fourier series and integrals. Special efforts is made to present Lighthill's scientific work in a simple and concise manner, and generally intelligible to readers who have some introduction to fluid mechanics. The book also includes a list of Lighthill's significant papers. Written for the mathematically literate reader, this book also provides a glimpse of Sir James' serious attempt to stimulate interest in mathematics and its diverse applications among the general public of the world, his profound influence on teaching of mathematics and science with newer applications, and his deep and enduring concern on enormous loss of human lives, economic and marine resources by natural hazards. By providing detailed background information and knowledge, sufficient to start interdisciplinary research, it is intended to serve as a ready reference guide for readers interested in advanced study and research in modern fluid mechanics. Contents:An Early Life History and Career of Sir James LighthillMusic and SwimmingPersonal ReminiscenceSir James Lighthill's BooksSupersonic and Subsonic Aerodynamic FlowsAeroacoustics and Nonlinear AcousticsBoundary Layer Theory and Vorticity DynamicsLinear and Nonlinear Waves in FluidsGeophysical Fluid DynamicsNonlinear Dispersive WavesNonlinear Diffraction of Water Waves by Offshore StructuresBiofluid MechanicsBooks and Major Research Papers of Sir James Lighthill Readership: Senior undergraduate or first-year graduate students in mathematics; professionals working on modern applied mathematics, mathematical physics, mechanical and aerospace engineering, linear and nonlinear waves, biofluiddynamics, plasma physics, nonlinear acoustics, nonlinear dynamics, aerodynamics, boundary layer theory and generalized functions and their applications. Keywords:Sir James Lighthill;Fluid Mechanics;Aerodynamics;Aeroelasticity;Biofluiddynamics;Linear and Nonlinear Wave Propagation;Boundary Layer Theory;Generalized Functions;Fourier Series and Integrals;Geophysical Fluid Dynamics;Dynamics of OceansKey Features:Offers a short and concise biography of Lighthill, with a description of both his life and his workDescribes a wide variety of major contributions of Lighthill, accompanied by his pioneering work on several fields of modern fluid mechanicsProvides a lot of information that puts the reader at the forefront of current researchServes as a research reference book and will prove

invaluable to college and university libraries that support active research in applied mathematics, fluid mechanics and engineering scienceReviews:“The author has produced an erudite scholarly book on the ideas of one of the most important British applied mathematicians. The printing and production are excellent. The book will be of great interest to all those involved with fluid mechanics. This is a superb piece of work and it throws new light on one of the most fundamental topics of mechanics. This book can be thoroughly recommended.”Mathematical Reviews

This textbook provides a clear and concise introduction to both theory and application of fluid dynamics, suitable for all undergraduates coming to the subject for the first time. It has a wide scope, with frequent references to experiments, and numerous exercises illustrating the main ideas.