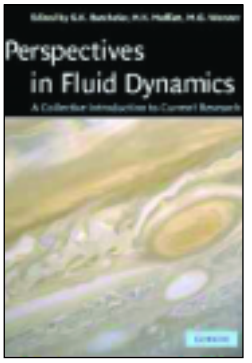
Books

Perspectives in Fluid Dynamics: A Collective Introduction to Current Research



Edited by G. K. Batchelor, K. K. Moffatt and M. G. Worster, Cambridge University Press, 646 pp. $160, 2001

This is a fascinating and rather unusual book in several ways. It includes eleven chapters by eleven distinguished authors, each providing an introduction to their research specialties within fluid dynamics. It is fascinating in that the topics included cover a wide range of subjects, most of which would not be considered to be "mainstream" fluid-dynamics areas, but which nevertheless have relevance to many common and practical applications. It is unusual in that the level is introductory and didactic, rather than highly complex and mathematical, as is typical of most treatises concerned with advanced fluid-dynamics topics. As such, each chapter stands alone, and can be comprehended by anyone with a basic understanding of fundamental fluid mechanics.

The first few chapters involve a progression from laminar and unstable flows to turbulence, and deal with such topics as interfacial fluid dynamics, viscous fingering, blood flow in arteries and veins, open shear flow instabilities, and turbulence. Flows dominated by interfacial tension are important in applications such as coatings, as are viscous fingering instabilities, which are also crucial in secondary oil recovery in which large amplitude instabilities can cause the interface to adopt complex shapes and configurations. Flow in blood vessels involves interaction of the fluid with elastic and collapsible properties of the vessels, as well as complex bifurcations, flow separation and shear enhancement. Within more pure hydrodynamics, the understanding of convective flow instabilities, as well as temporal growth of instabilities, leads to a greater understanding and description of turbulence.

Buoyancy-driven flows are considered, in which the driving force may be temperature gradients or gradients of concentration of dissolved or suspended impurities, with application to geophysical situations, containment of reactive chemicals, ventilation, etc. Magnetohydrodynamic flows are driven by magnetic forces and the advection of the field by the flow. Since the magnetic field can actually be generated by the flow, the possibility of self-sustaining dynamo action exists. In another chapter, the boundaries of fluids undergoing solidification are considered, which in some cases can become so convoluted as to form a porous medium in which heat and mass transfer and fluid flow can occur.

Geophysical fluid flows on a more global scale are the subject of chapters devoted to the prediction of atmospheric flows and related weather phenomena, such as the dispersal of pollutants and the mixing and transport of heat, dissolved minerals and gases in the oceans that can also affect weather patterns. This is extended to flows beneath the surface and within the earth, from the rapid flows of molten iron in the outer core to the eruptions of lava and volcanic ash.

Each of the eleven chapters provides an interesting and informative introduction to the relevant topic, which is not only fascinating and educational, but quantitatively useful to anyone wishing to pursue each topic further.

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Transport Properties of Foods

George D. Saravacos and Zacharias B. Maroulis, Marcel Dekker, Inc., New York, NY, 415 pp., $165, 2001

Compared to chemicals and biochemicals, foods display complex characteristics that make the applicability of theoretical approaches difficult. Starting from fundamental transport properties applicable to simple fluids, this book compiles recent literature for transport properties of foods that include momentum, heat and mass transfer.

Specifically, the authors elaborate on rheology, moisture diffusivity, thermal conductivity and diffusivity, and heat- and mass-transfer coefficients of foods. In order to draw conclusions, statistical analysis of the literature data is presented and empirical equations are developed using dimensionless numbers. These empirical relations are useful for industrial applications. Throughout the text, several graphs are provided to make simple back-of-the-envelope calculations. The book is well organized and the material is presented with enough background information to allow the novice reader to comprehend the physical meaning of the plots. It stands out with its contemporary content, and will find its readers in the food industry, especially process engineers. The authors bring together the literature to generate several graphs that describe almost all the foods with characteristic behaviors. While being easy-to-follow for visual learners, these plots show the applicability of the engineering principles to food science.

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