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Introduction to Engineering Fluid Mechanics

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This book is prepared to familiarise engineering students with an analytical approach to the essential fundamentals of fluid Mechanics. It is designed as a text for a first course in fluid mechanics.

The book consists of 6 chapters in addition to 6 appendices, and an extensive number of solved examples and problems. In chapter 1, the fundamentals and definitions of some terminology are presented. Fluid statics are given in chapter 2. The chapter covers the concepts of pressure and its variation in the atmospheric layers and in incompressible fluids. Pressure measurements using manometers and Bourdon gauge are also covered by the chapter. The chapter also presents the analysis for the calculations of the hydrostatic forces or submerged surfaces and bodies, and the concept of the static stability of floating bodies.

In chapter 3, the basic relations governing the behaviour of non-viscous flows are introduced. In a systematic presentation, the concept of rotational and irrotational flow and flow through areas are given. Following both a control volume approach and a differential approach, the conservation of mass, momentum principle, and the energy equation are presented, and the continuity equation, Euler's equations, and Bernoulli's equation are derived and applied to various types of flows.

The effect of viscosity to external and internal flows is considered in chapter 4. The chapter starts with the definition of laminar and turbulent flows and the boundary layer concept. The analysis of the boundary layer flow over a flat plate is then given,

followed by the calculations of the drag and left forces on various geometries. Chapter 4 also covers fully developed flows in pipes and in circular and noncircular ducts. By means of several solved examples, the calculations of the major and minor losses of flow in pipes and ducts are shown.

In chapter 5, an introduction to compressible flow is given. Analyses are also given for the stagnation properties of isentropic flow of a perfect gas at subsonic and supersonic flow ranges. A detailed procedure is given for nozzle design.

In chapter 6, dimensional analysis using the π-theorem is introduced. The conditions to design a laboratory experiment are discussed (physical similarity). The six appendices at the end of the book contain many useful engineering data.