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Second Edition

Fluid Mechanics and Machinery

C.P. KOTHANDARAMAN
R. RUDRAMOORTHY

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(Second Edition)

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Preface to the Second Edition

This book Basic Fluid Mechanics is revised and enlarged by the addition of four chapters on Hydraulic Machinery and is now titled as Fluid Mechanics and Machinery. The authors hope this book will have a wider scope.

This book will be suitable for the courses on Fluid Mechanics and Machinery of the various branches of study of Anna University and also other Indian universities and the Institution of Engineers (India).

Professor Obert has observed in his famous treatise on Thermodynamics that concepts are better understood by their repeated applications to real life situations. A firm conviction of this principle has prompted the author to arrange the text material in each chapter in the following order.

In the first section after enunciating the basic concepts and laws, physical and mathematical models are developed leading to the formulation of relevant equations for the determination of outputs. Simple and direct numerical examples are included to illustrate the basic laws. More stress is on the model development as compared to numerical problems.

A section titled "SOLVED PROBLEMS" comes next. In this section more involved derivations and numerical problems of practical interest are solved. The investigation of the effect of influencing parameters for the complete spectrum of values is attempted here. Problems involving complex situations are shown solved in this section. It will also illustrate the range of values that may be expected under different situations. Two important ideas are stressed in this section. These are (1) checking for dimensional homogeneity in the case of all equations derived before these equations can be used and (2) The validation of numerical answers by cross checking. This concept of validation in professional practice is a must in all design situations.

In the next section a large number of objective type questions with answers are given. These are very useful for understanding the basics and resolving misunderstandings.

In the final section a large number of graded exercise problems involving simple to complex situations, most of them with answers, are included.

The material is divided into sixteen chapters. The first chapter deals in great detail with properties of fluids and their influence on the operation of various equipments. The next chapter discusses the determination of variation of pressure with depth in stationary and moving fluids. The third chapter deals with determination of forces on surfaces in contact with stationary fluids. Chapter four deals with buoyant forces on immersed or floating bodies and the importance of metacentric height on stability. In chapter five basic fluid flow concepts and hydrodynamics are discussed.

Energy equations and the variation of flow parameters along flow as well as pressure loss due to friction are dealt with in chapter six.

In chapter seven flow in closed conduits including flow in pipe net work are discussed.

Dimensional analysis and model testing and discussed in a detailed manner in chapters eight and nine. Boundary layer theory and determination of forces due to fluid flow on bodies are dealt with in chapter ten.

In chapter eleven various flow measuring methods and instruments are described. Flow in open channels is dealt with in detail in chapter twelve.

Chapter thirteen deals with dynamics of fluid flow in terms force exerted on surface due to change of momentum along the flow on the surface.

Chapter fourteen deals with the theory of turbo machines as applied to the different type of hydraulic turbines. The working of centrifugal and axial flow pumps is detailed in chapter fifteen. The last chapter sixteen discusses the working of reciprocating and other positive displacement pumps.

The total number of illustrative worked examples is around five hundred. The objective questions number around seven hundred. More than 450 exercise problems with answers are also included.

The authors thank all the professors who have given very useful suggestions for the improvement of the book.

Authors

Preface to the First Edition

This book is intended for use in B.E./B.Tech. courses of various branches of specialisation like Civil, Mechanical and Chemical Engineering. The material is adequate for the prescribed syllabi of various Universities in India and the Institution of Engineers. SI system of units is adopted throughout as this is the official system of units in India. In order to give extensive practice in the application of various concepts, the following format is used in all the chapters.

- Enunciation of Basic concepts
- Development of physical and mathematical models with interspersed numerical examples
- Illustrative examples involving the application and extension of the models developed
- Objective questions and exercise problems

The material is divided into 12 chapters. The first chapter deals in great detail with properties of fluids and their influence on the operation of various equipments. The next two chapters discuss the variation of pressure with depth in liquid columns, at stationary and at accelerating conditions and the forces on surfaces exerted by fluids. The fourth chapter deals with buoyant forces and their effect on floating and immersed bodies. The kinetics of fluid flow is discussed in chapter five.

Energy equations and the determination of pressure variation in flowing fluids and loss of pressure due to friction are discussed in chapters six and seven.

Dimensional analysis and model testing are discussed in a detailed manner in chapters eight and nine.

Boundary layer theory and forces due to flow of fluids over bodies are discussed in chapter ten. Chapter eleven details the methods of measurement of flow rates and of pressure in fluid systems. Open channel flow is analyzed in chapter twelve.

The total number of illustrative numerical examples is 426. The objective questions included number 669. A total number of 352 exercise problems, mostly with answers are available.

We wish to express our sincere thanks to the authorities of the PSG College of Technology for the generous permission extended to us to use the facilities of the college.

Our thanks are due to Mr. R. Palaniappan and Mr. C. Kuttumani for their help in the preparation of the manuscript.

C.P. Kothandaraman

R. Rudramoorthy

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