

# Contents

	<i>Preface</i>	<i>iii</i>
Chapter 1	Structure of Flow	1
	Introduction and the Residence Time Concept	1
	Regimes of Flow	21
	Conclusion	53
	Notation	53
	References	54
Chapter 2	Overview of Turbulence Measurements	56
	Basic Definitions and Measurement Requirements	56
	Measuring Pressure	58
	Measuring Flow Velocity	60
	Measuring Temperature and Concentration	62
	Characterizing Turbulence Measurements	64
	Notation	74
	References	75
Chapter 3	Principles of Thermal Anemometry	76
	Introduction and Basic Features	76
	Heat Transfer	80

	Velocity Components	87
	Nonisothermal Flows	93
	Measuring Gas Mixture Concentrations (Supersonic Flows)	94
	Signal Analysis and Correlation Functions	101
	Film Sensors	109
	Notation	112
	References	112
<b>Chapter 4</b>	<b>Techniques for Two-Phase Flow Investigations</b>	<b>114</b>
	Introduction	114
	Transducers and Electroresistivity Sensors	114
	Sensors Based on Electromagnetic Waves	132
	Sensors Based on Mechanical Waves	153
	Notation	173
	References	173
<b>Chapter 5</b>	<b>Flow Experimentation Using Optical and Light- Scattering Principles</b>	<b>175</b>
	Introduction	175
	Principles of Light Transmission and Optics	175
	Application of Photographic and Optical Techniques to Flow Studies	202
	Light Scattering and Fiber Optics	221
	Holography	227
	Application of Laser Doppler Anemometry	231
	Notation	249
	References	250
<b>Chapter 6</b>	<b>Flow Metering of Industrial Process Streams</b>	<b>254</b>
	Introduction	254
	Displacement and Nonmechanical Flow Devices	254
	Mechanical and Positive Displacement Meters	280
	Mag Meters	303
	Notation	315
	References	316
<b>Chapter 7</b>	<b>Analyzing and Controlling Open Channel and Partial Pipe Flows</b>	<b>317</b>
	Introduction	317
	Analysis of Flows	317

## Contents

vii

<b>Flow Measurements with Flumes and Weirs</b>	<b>347</b>
<b>Open Flow Nozzle</b>	<b>362</b>
<b>Estimating Flows from the Manning Formula</b>	<b>371</b>
<b>Ultrasonic Flow Measurement</b>	<b>371</b>
<b>Notation</b>	<b>377</b>
<b>References</b>	<b>377</b> ,
<b><i>Index</i></b>	<b>381</b>