CONTENT

		Page
Preface		xiv
Chapter 1	SENSORS	1
	Applications of Instrumentation	1
	Introduction to Sensor Fundamentals	2
	Standards of Measurement	10
	Level Measurement	11
	Pressure Measurement	31
	Flow Measurement	61
	Thermometers	95
	Weight Measurement	139
	About the Authors	150
Chapter 2	ANALYTICAL INSTRUMENTATION	151
	Process Chromatography	152
	Thermal Conductivity Detectors	168
	Combustion Analyzers	170
	Infrared Analyzers	170
	Density Analyzers	171
	Viscosity Analyzers	173
	Acidity and Alkalinity Analyzers	174
	Electrical Conductivity Meters	176
	Miscellaneous Analyzers	177
	Bibliography	178
	About the Author	179
Chapter 3	THE PROCESS AND PROCESS CONTROL	181
	Processes	181
	Basic Concepts and Process Control	199
	Traditional Control Strategies	209
	References and Bibliography	224
	About the Author	225
Chapter 4	FINAL CONTROL ELEMENTS	227
	Control Valves and Actuators – An Introduction	227
	Pressure Differential	235
	Control Valve Sizing	238
	Trim Design	254
	Actuators	254
	Valve Positioners and Accessories	258
	Reversible Electronic Motor Drives	263
	Solenoid Valves	264
	Electric Motor Drive Control	265
	Regulators, Relief Valves, and Other Control Elements	268
	Summary	277
	Bibliography	277
	About the Author	279
Chapter 5	COMPUTER TECHNOLOGY	281
	The Digital computer	281
	The Central Processing Unit (CPU)	284
	Computer Architecture : Components and Structure	288

	Physical Assembly of a Computer	307
	Hierarchy of Computers	308
	Computer Operating Environment	310
	Operating Systems	314
	Communications	323
	Networks	332
	Applications	345
	Artificial Intelligene and Expert Systems	385
	Neural Networks	364
	Robotics	377
	Machine Vision	382
	Speech Recognition and Synthesis	385
	References and Bibliography	388
	About the Author	392
Chapter 6	CONTROL SYSTEM THEORY	393
	The Transfer Function	393
	Open and closed Loops	393
	Block Diagrams	394
	Modeling 398	
	Block Diagram Reduction Techniques	403
	Signal Flow Graphs	404
	Differential Equations	408
	Transform Calculus Using the Laplace Transform	409
	System Response and Bode Diagrams	412
	Stability	426
	Performance Indices	431
	Compensation	432
	The Z-Transform	434
	State-Space Approach to Digital control Systems	435
	Predictive Control	439
	Adaptive control	439
	Statistical Process Control	443
	Expert Systems	444
	References	446
	About the Author	446
Chapter 7	ANALOG AND DIGITAL CONTROL DEVICES	447
	Automatic Controllers	447
	Pneumatic Controllers	447
	Pneumatic Auxiliary Devices	453
	Electric and Electronic Controllers	454
	Electronic Auxiliary Devices	458
	Digital Controllers	461
	About the Author	476
Chapter 8	DISTRIBUTED CONTROL SYSTEMS	477
	Introduction	477
	DCS Architecture	482
	Input / Output Modules	484
	User Interfaces	489
	Basic DCS Software Modules	502
	Supplier Software Examples	504
	Installation 507	
	Maintenance	520
	Purchasing Strategies	532
	References 534	
	About the Author	535
Chapter 9	PROGRAMMABLE LOGIC CONTROLLERS	537
	Introduction	538

	Ladder Logic Concepts	541
	Processors	548
	The Memory System	555
	The Discrete Input / Output System	562
	The Analog I / O Systems	578
	Special Function Interfacing	585
	Programming Languages	589
	PLC System Documentation	593
	Implementing and Programming the PLC	599
	Guidelines for Installation, Start-Up, and Maintenance	607
	References and Bibliography	622
	About the Author	623
Chapter 10	ERGONOMICS AND OCCUPATIONAL SAFETY	625
	The Aims of Ergonomics	625
	Information Ergonomics in Industrial Control	626
	Planning Control Centers	631
	Personnel Training	641
	Occupational Safety	643
	Bibliography	651
	About the Author	651
Chapter 11	PROJECT MANAGEMENT STRATEGIES	653
	Standards	653
	Documentation	655
	Instrumentation Projects	669
	Engineering Phases	673
	Site Work	694
	Conclusion	695
	Bibliography	695
	About the Author	696
Chapter 12	APPENDICES	
	1. Instrument Laboratory	697
	2. Electricity	761
	3. Chemistry	777
Index		787