

Contents

Nº 1 4 1 1

PREFACE

xi

1 4 MEDICAL INSTRUMENTATION

1

- 1.1 *Medical instrumentation systems* 1
- 1.2 *Electrocardiography* 5
- 1.3 *Pulmonary instrumentation* 22
- 1.4 *Anesthesia machines and surgical monitoring* 36
- 1.5 *EEG monitoring* 42
- 1.6 *Blood pressure* 44
- 1.7 *Clinical chemistry* 49
- References* 57
- Problems* 58

2	ANALOG-TO-DIGITAL AND DIGITAL-TO-ANALOG CONVERSION	61
	2.1 <i>Conversion basics</i>	62
	2.2 <i>Digital-to-analog converters</i>	72
	2.3 <i>Analog-to-digital converters</i>	76
	2.4 <i>Other parts of an analog-to-digital system</i>	84
	2.5 <i>Systems and specifications</i>	88
	<i>References</i>	89
	<i>Problems</i>	89
3	SIGNAL PROCESSING—HARDWARE VERSUS SOFTWARE	91
	3.1 <i>Filters</i>	92
	3.2 <i>Derivative</i>	126
	3.3 <i>Integration</i>	140
	3.4 <i>Fourier analysis</i>	148
	3.5 <i>Peak and valley detection</i>	156
	<i>References</i>	163
	<i>Problems</i>	165
4	MICROCOMPUTER DESIGN	167
	4.1 <i>Introduction to the microcomputer system</i>	167
	4.2 <i>Microprocessor hardware design</i>	171
	4.3 <i>Memory hardware design</i>	187
	4.4 <i>Input/output hardware design</i>	208
	4.5 <i>Software design</i>	240
	4.6 <i>Model microprocessors</i>	274
	<i>References</i>	287
	<i>Problems</i>	289
5	APPLICATIONS IN EXISTENCE	293
	5.1 <i>General signal processors</i>	293
	5.2 <i>ECG acquisition and transmission</i>	308
	5.3 <i>Physiological monitoring</i>	313
	5.4 <i>Pulmonary instrumentation</i>	325
	5.5 <i>Anesthesia machine</i>	330
	5.6 <i>Operating room monitoring</i>	332
	5.7 <i>Electroencephalography</i>	335
	5.8 <i>Blood pressure</i>	339
	5.9 <i>Clinical chemistry</i>	343

- 5.10 *Sensory monitoring and aids* 349
- 5.11 *Communication and training aids for the handicapped* 354
- 5.12 *Diagnostic ultrasound* 359
- 5.13 *Pacemakers* 361
- 5.14 *Medical imaging* 363
- 5.15 *Stimulators* 365
- 5.16 *Prosthetics* 368
- 5.17 *General microprocessor-based medical devices* 375
 - References* 382
 - Problems* 388

6

A DETAILED DESIGN EXAMPLE—
AMBULATORY ECG MONITORING

390

- 6.1 *Present monitoring methods—an introduction to a portable arrhythmia monitor* 391
- 6.2 *Defining the physiological problem* 392
- 6.3 *Instrument specifications* 399
- 6.4 *Ambulatory ECG monitoring system* 405
- 6.5 *Choice of hardware* 408
- 6.6 *Analog circuit development* 412
- 6.7 *Microcomputer development* 420
- 6.8 *Data-reduction algorithms* 433
- 6.9 *Software development* 448
- 6.10 *System testing* 455
- 6.11 *Project evaluation* 458
 - References* 461
 - Problems* 462

APPENDICES

465

- 1 *Glossary* 465
- 2 *ASCII/Hexadecimal conversion* 470
- 3 *Hexadecimal-to-decimal conversion* 471
- 4 *Instruction sets for the COSMAC and the Z80* 472
- 5 *Comparisons of microcomputer-based medical instruments* 474
- 6 *Laboratory microcomputer systems* 477

INDEX

481