

Contents

<i>Preface to the Second Edition</i>	vii
<i>Preface to the First Edition</i>	ix
1. Introduction to Embedded Systems	1
1.1 Embedded Systems	3
1.2 Processor Embedded into a System	5
1.3 Embedded Hardware Units and Devices in a System	10
1.4 Embedded Software in a System	19
1.5 Examples of Embedded Systems	27
1.6 Embedded System-on-chip (Soc) and Use of VLSI Circuit Design Technology	29
1.7 Complex Systems Design and Processors	32
1.8 Design Process in Embedded System	37
1.9 Formalization of System Design	42
1.10 Design Process and Design Examples	43
1.11 Classification of Embedded Systems	52
1.12 Skills Required for an Embedded System Designer	53
2. 8051 and Advanced Processor Architectures, Memory Organization and Real-world Interfacing	61
2.1 8051 Architecture	62
2.2 Real World Interfacing	72
2.3 Introduction to Advanced Architectures	84
2.4 Processor and Memory Organization	96
2.5 Instruction-Level Parallelism	104
2.6 Performance Metrics	106
2.7 Memory-Types, Memory-Maps and Addresses	106
2.8 Processor Selection	113
2.9 Memory Selection	118
3. Devices and Communication Buses for Devices Network	128
3.1 IO Types and Examples	130
3.2 Serial Communication Devices	134
3.3 Parallel Device Ports	143
3.4 Sophisticated Interfacing Features in Device Ports	150
3.5 Wireless Devices	151
3.6 Timer and Counting Devices	152
3.7 Watchdog Timer	157
3.8 Real Time Clock	158
3.9 Networked Embedded Systems	159
3.10 Serial Bus Communication Protocols	160
3.11 Parallel Bus Device Protocols—Parallel Communication Network Using ISA, PCI, PCI-X and Advanced Buses	166
3.12 Internet Enabled Systems—Network Protocols	170
3.13 Wireless and Mobile System Protocols	175
4. Device Drivers and Interrupts Service Mechanism	187
4.1 Programmed-I/O Busy-wait Approach without Interrupt Service Mechanism	189

4.2	ISR Concept	192	
4.3	Interrupt Sources	200	
4.4	Interrupt Servicing (Handling) Mechanism	203	
4.5	Multiple Interrupts	209	
4.6	Context and the Periods for Context Switching, Interrupt Latency and Deadline	211	
4.7	Classification of Processors Interrupt Service Mechanism from Context-Saving Angle	217	
4.8	Direct Memory Access	218	
4.9	Device Driver Programming	220	
5.	Programming Concepts and Embedded Programming in C, C++ and Java		234
5.1	Software Programming in Assembly Language (ALP) and in High-Level Language 'C'	235	
5.2	C Program Elements: Header and Source Files and Preprocessor Directives	237	
5.3	Program Elements: Macros and Functions	239	
5.4	Program Elements: Data Types, Data Structures, Modifiers, Statements, Loops and Pointers	241	
5.5	Object-Oriented Programming	262	
5.6	Embedded Programming in C++	263	
5.7	Embedded Programming in Java	264	
6.	Program Modeling Concepts		273
6.1	Program Models	274	
6.2	DFG Models	277	
6.3	State Machine Programming Models for Event-controlled Program Flow	282	
6.4	Modeling of Multiprocessor Systems	288	
6.5	UML Modelling	295	
7.	Interprocess Communication and Synchronization of Processes, Threads and Tasks		303
7.1	Multiple Processes in an Application	305	
7.2	Multiple Threads in an Application	306	
7.3	Tasks	308	
7.4	Task States	308	
7.5	Task and Data	310	
7.6	Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics	311	
7.7	Concept of Semaphores	314	
7.8	Shared Data	326	
7.9	Interprocess Communication	330	
7.10	Signal Function	332	
7.11	Semaphore Functions	334	
7.12	Message Queue Functions	335	
7.13	Mailbox Functions	337	
7.14	Pipe Functions	339	
7.15	Socket Functions	341	
7.16	RPC Functions	345	
8.	Real-Time Operating Systems		350
8.1	OS Services	351	
8.2	Process Management	355	
8.3	Timer Functions	356	
8.4	Event Functions	358	
8.5	Memory Management	359	