

CONTENTS

CHAPTER ONE

Number Systems and Boolean Algebra

1

- 1.1 Introduction 1
- 1.2 Number Systems 2
- 1.3 Conversion between Different Bases 3
- 1.4 Representation of Negative Numbers 10
- 1.5 Binary Arithmetic Operations 12
- 1.6 Binary Codes 16
- 1.7 Logic Operations 19
- 1.8 Logic Functions from Truth Tables 24
- 1.9 Boolean Algebra 28
- 1.10 Summary 33
- Problems 33
- Suggested Readings 36

CHAPTER TWO

Minimization of Logic Functions

39

- 2.1 Introduction 39
 - 2.2 Binary Space and Karnaugh Maps 40
 - 2.3 POS Form from K-Maps 48
 - 2.4 Don't-Care Terms in K-Maps 50
 - 2.5 Combinational Hazards 52
 - 2.6 Cellular Arithmetic 56
 - 2.7 Single-Output Quine-McCluskey's Tabular Reduction 58
 - 2.8 Don't-Cares in Q-M Tabular Reduction 62
 - 2.9 Multiple-Output Q-M Tabular Reduction 66
-

2.10	Summary	68
	Problems	68
	Suggested Readings	70

CHAPTER THREE

Integrated Circuits

71

3.1	Introduction	71
3.2	Logic Circuit Families	72
3.3	IC Specifications	79
3.4	TTL Overview	82
3.5	Open-Collector and Tri-State Outputs	89
3.6	Interfacing of Different Families	94
3.7	Summary	94
	Problems	95
	Suggested Readings	95

CHAPTER FOUR

Implementation of Logic Functions

97

4.1	Introduction	97
4.2	Universal Logic Elements	98
4.3	Function Implementation Using NANDs	101
4.4	Function Implementation Using NORs	102
4.5	Function Implementation Using MUXs	105
4.6	Function Implementation Using ROMs	114
4.7	Function Implementation Using PLAs and PALs	119
4.8	Bridging Technique	123
4.9	Summary	127
	Problems	127
	Suggested Readings	128

CHAPTER FIVE

Design of Combinational Circuits

130

5.1	Introduction	130
5.2	Binary Adders	131
5.3	Binary Subtractors	141
5.4	Carry Look-Ahead (CLA) Adders	143
5.5	Code Converters	149
5.6	BCD Arithmetic Circuits	162
5.7	Arithmetic Logic Unit (ALU)	170
5.8	Decoders and Encoders	173
5.9	Error-Control Circuits	184

- 5.10 Summary 191
- Problems 191
- Suggested Readings 194

CHAPTER SIX

Sequential Devices

196

- 6.1 Introduction 196
- 6.2 Latches 197
- 6.3 Clocked *SR* Flip-Flop 202
- 6.4 *JK* Flip-Flop 205
- 6.5 Master-Slave Flip-Flop 209
- 6.6 Delay and Trigger Flip-Flops 212
- 6.7 Monostable Flip-Flop 215
- 6.8 Sequential Circuits 216
- 6.9 Summary 220
- Problems 220
- Suggested Readings 223

CHAPTER SEVEN

Design of Synchronous Sequential Circuits 225

- 7.1 Introduction 225
- 7.2 State Diagrams and State Tables 225
- 7.3 Equivalent States 230
- 7.4 State Assignments 234
- 7.5 Excitation Maps 235
- 7.6 Design Algorithm 237
- 7.7 Incompletely Specified Diagrams 247
- 7.8 Ideal State Assignments 250
- 7.9 Summary 250
- Problems 251
- Suggested Readings 254

CHAPTER EIGHT

Design of Pulse-Mode Circuits

255

- 8.1 Introduction 255
- 8.2 Pulse-Mode Model 255
- 8.3 Design Algorithm 257
- 8.4 Summary 266
- Problems 266
- Suggested Readings 267

**CHAPTER
NINE****Design of Fundamental-Mode Circuits**

269

- 9.1 Introduction 269
- 9.2 Analysis of Level Sequential Circuits 270
- 9.3 Flow Table Generation 272
- 9.4 Cycles and Races 278
- 9.5 Fundamental-Mode Output Maps 289
- 9.6 Summary 292
 - Problems 292
 - Suggested Readings 295

**CHAPTER
TEN****Introduction to Counters, Registers, and
Register Transfer Language**

296

- 10.1 Introduction 296
- 10.2 Synchronous Binary Counters 297
- 10.3 Asynchronous Binary Counters 307
- 10.4 IC Counters 312
- 10.5 Basic Serial Shift Registers 315
- 10.6 Parallel-Load Shift Registers 319
- 10.7 Universal-Shift Registers 321
- 10.8 Shift Registers as Counters 323
- 10.9 Counter and Register Applications 326
- 10.10 Bus Concept 331
- 10.11 Register Transfer Language Operations 342
- 10.12 RTL Applications 348
- 10.13 Summary 353
 - Problems 354
 - Suggested Readings 357

**CHAPTER
ELEVEN****Design of Advanced Arithmetic Circuits**

359

- 11.1 Introduction 359
- 11.2 Binary Serial Adder/Subtractor 360
- 11.3 Serial-Parallel Multiplication Schemes 368
- 11.4 Combinational Array Multiplier Logic 380
- 11.5 Carry-Save Multiplication 384
- 11.6 Booth's Multi-Bit Algorithm 385
- 11.7 Techniques for Division 388
- 11.8 Summary 394
 - Problems 394
 - Suggested Readings 396

**CHAPTER
TWELVE****Memory Devices 399**

- 12.1 Introduction 399
- 12.2 Memory Basics 400
- 12.3 Magnetic Core Memories 403
- 12.4 Magnetic Bubble Memories 409
- 12.5 RAM Characteristics 410
- 12.6 Bipolar RAM 411
- 12.7 MOS Static RAM 415
- 12.8 MOS Dynamic RAM 416
- 12.9 PROMs 419
- 12.10 Optical Memories 420
- 12.11 Summary 423
 - Problems 423
 - Suggested Readings 424

**CHAPTER
THIRTEEN****Processor Design and Microprogramming 425**

- 13.1 Introduction 425
- 13.2 Computer Architecture 425
- 13.3 Machine Language 427
- 13.4 LIS-4 Processor Design 428
- 13.5 Microprogramming 445
- 13.6 LIS-4 Processor Microprogrammed Control 449
- 13.7 Microprogrammed Algorithm Control 458
- 13.8 Summary 460
 - Problems 461
 - Suggested Readings 462

**CHAPTER
FOURTEEN****Input/Output and Interfacing Design 464**

- 14.1 Introduction 464
- 14.2 Small System I/O 464
- 14.3 Interfacing 473
- 14.4 Analog-to-Digital and Digital-to-Analog Converters 481
- 14.5 Conclusion 489
 - Problems 489
 - Suggested Readings 490
 - Reference Data 491

Index 493