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Fundamentals of Modern Digital Systems

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Second Edition

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Preface to Second Edition

“One should teach things which will still be valid
in twenty years’ time: the fundamental concepts
and underlying principles. Anything else is dishonest.”

Professor G. Strachey, 1969

Professor Strachey’s basic requirement of any course is just as important today as it was twenty years ago, but the difficulty is always in deciding exactly what constitutes the core material. In a field developing as rapidly as digital electronics it is even more difficult to determine how many of the current techniques should be included to allow the student to appreciate the significance of that core material. Twenty years ago the integrated logic circuit itself had yet to make an impact.

This book, therefore, presents the fundamental principles common to all modern digital electronic systems, and is intended to provide a solid foundation for the study of such systems at first degree or equivalent level. Some of the topics covered in the later chapters are also relevant to post-graduate studies. This second edition reflects the continuing rapid pace of developments in the digital field over recent years, and is a completely revised, updated, and in some cases rearranged book, re-emphasizing the underlying principles in a modern framework.

The first three chapters introduce the ideas basic to all digital systems; the two-state algebra used in combinational logic (chapter 1), the two-valued representation of data (chapter 2), and the methods of building two-state electronic circuits used in the different families of logic (chapter 3). Chapter 1 now includes an introduction to symmetric functions, and bar codes have been introduced in chapter 2 to illustrate some of the special coding techniques. Chapter 3 has been reshaped to cater for the shift in emphasis over recent years from bipolar to unipolar circuitry, with an outline of VLSI principles. The need to consider the testing of circuits at all stages in the design process is stressed throughout the book.

The next three chapters, 4, 5, and 6, cover design methods involving the use of large scale integrated devices; chapter 4 considers logic design techniques for

combinational circuits and includes a new section on custom design. The material in chapter 5 of the first edition has been reworked and considerably extended so that sequential logic is now split into two chapters: 5 covers sequential logic components, and 6 deals with the more formal analysis and design of sequential circuits. This allows an introduction to linear feedback shift registers and timing circuits to be included in chapter 5, and the algorithmic state machine chart representation in chapter 6.

Chapter 7 explains the principles of memory systems, and chapter 8 is devoted to programmable devices. Again, the fundamental concepts are emphasized rather than specific device details, though typical usage is quoted freely to illustrate the ideas. Finally, chapter 9 deals with some of the techniques associated with the operation of digital systems, especially those involving data transmission and conversion between the analog and digital forms.

One of the major decisions in any book of this type is what logic symbols to use. Although international standards have now moved to rectangular symbol shapes, we have decided to use the well-known Mil. Spec. symbols which indicate the logic function by their shape and have the advantage of both simplicity and being readily understood. We have, however, included in appendix A an introduction to the current international standard, which is designed to allow meaningful symbols to be developed for even very complex circuits such as those found in VLSI devices.

Worked examples are included throughout the text, and each chapter concludes with problems for the reader and references for further work.

We are indebted to our many students, past and present, who have knowingly and unknowingly contributed to the formation of our ideas on the presentation of the material, and who have made this new edition both possible and worth while.

Hull,
1987

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