PREFACE TO THE FIRST EDITION

The tremendous power and usefulness of digital electronics can be seen from the wide variety of industrial and consumer products, such as automated industrial machinery, computers, microprocessors, pocket calculators, TV games, digital watches and clocks which are based on the principles of digital electronics. The areas of applications of digital electronics have been increasing every day. In fact, digital systems have invaded all walks of life.

One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuits (ICs). Developments in IC technology have made it possible to fabricate complex digital circuits, such as microprocessors and memory units on tiny chips of silicon.

The wonderchip—the microprocessor has been the most fantastic development of recent years. No other single development has affected our lives as much as the microprocessor in such a short time. Its ever-increasing applications have resulted in developments which were simply unheard of till a few years ago.

This has made it imperative for all those who will be required to design, develop, test, and maintain various electronic systems to learn the principles of modern digital devices and systems.

Availability of complex digital functions in ICs has created the need for a change in the teaching philosophy of digital electronics from the conventional style using discrete devices to a new style using modern digital ICs. For example, now it is no more important to minimise the number of gates for the design of a digital circuit, since a number of similar gates are available in a single IC chip; rather, it has become necessary to minimise the number of IC packages. Thus, the present-day designer of digital systems has to be thoroughly familiar with the principles of operation and flexibilities available in various ICs in order to optimise the design of systems from the point of view of cost, space, power requirement, speed of operation, etc.

With this in view, an attempt has been made to introduce the concepts of modern digital techniques and ICs (available) for the realisation of various functions. This book is self-contained and is suitable for a course in digital systems for engineering and computer science programmes. Students of physics specialising in electronics will also find the book useful. For experimental work, the reader is advised to refer to Jain and Anand, Digital Electronics Practice Using Integrated Circuits, Tata McGraw Hill, 1983.

The book has been systematically organised and the presentation has been kept at a level suitable for a student with a basic knowledge of circuit theory and electronics.

Chapter 1 introduces the fundamental concepts of digital electronics, advantages of digital systems and basic digital circuits. Chapter 2 reviews semiconductor devices from the point of view of their applications in digital circuits. Based on these devices, various digital circuits, referred to as logic families, have been discussed in Chapter 3. This also deals with the interfacing problems between ICs of same logic families and between those of different logic families. Necessary number systems and commonly used codes in digital systems and microprocessors have been discussed in Chapter 4.

Chapter 5 deals with the conventional methods of combinational system design. The importance of the methods, such as the Karnaugh map technique, has gone down because of simpler methods required to design the same systems using other functions such as multiplexers, demultiplexers and PLAs which are easily available in ICs. Combinational logic design using MSI circuits is covered in Chapter 6 which assumes greater importance for the design of digital systems due to considerations of simplicity in design, cost, space, power requirement, speed, etc.

Chapter 7 introduces the basic building block of a sequential circuit—the FLIP-FLOP. All types of FLIP-FLOPs with their excitation tables and triggering methods have been discussed in detail. Sequential logic design has been discussed in Chapter 8. Here again, both the approaches, namely conventional design using FLIP-FLOPs and the modern method using available MSI circuits, have been discussed.

Chapter 9 deals with timing circuits which are an essential part of a digital system. Timing circuits using various ICs, such as gates, OP AMP, Schmitt trigger, monostable multivibrator, and 555 Timer, have been discussed.

The analog-to-digital (A/D) and digital-to-analog (D/A) converters form an important part of many digital systems and the commonly used techniques have been discussed in Chapter 10.

Chapter 11 deals with semiconductor memories which have assumed an important role in present-day digital systems. Various semiconductor memories, such as static and dynamic shift register memories, static and dynamic RAMs, ROM, PROM, EPROM, EAROM, CAM, and CCD, have been discussed in detail. Programming techniques used for programmable ROMs and erasing techniques used for erasable programmable ROMs have also been discussed thoroughly. The LSI device PLA which is very useful for digital system design has been introduced in a very simple and systematic way which will help the reader to understand the operation and usefulness of this device for digital system design.

The microprocessor has been introduced in Chapter 12. The fundamentals of microprocessors have been presented in a manner which will help a novice understand this highly sophisticated device. The most widely used Intel's 8085A 8-bit microprocessor has been chosen for discussion. Its organisation, operation and programming have been discussed in detail, which will help the reader learn the use of microprocessors.

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