A TEXTBOOK OF ELECTRONIC DEVICES AND CIRCUITS

(For the Students of B.E./B.Tech.)

Dr. R.S. SEDHA

S. CHAND

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PREFACE

I take an opportunity to present this standard treatise entitled ''A Text Book of Electronic Devices and Circuits'' especially to the students of B.E./B.Tech. of all Indian Universities in general.

The book covers topics from the Ist year B.Tech Electronics & Communication Engineering degree programme.

The objective of this book is to present the subject matter in a most concise, compact, to the point and lucid manner. While writing this book, I have constantly kept in mind the requirements of all the students, regarding the latest as well as changing trend of their examinations. To make it really useful for the students, latest examination questions of various Indian and foreign universities as well as other important examining bodies have been included. The book has been written in an easy style with full details and illustration. All along the approach to the subject matter, every care has been taken to arrange the matter from simpler to harder, known to unknown, in a self-study style. In-short, it is expected that the book will meet the crying need of the students for whom it has been produced.

The textbook has been divided into 8 units and arranged in 22 chapters. This material can accommodate a variety of scheduling and program requirements.

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TO THE STUDENTS OF B.E./B.Tech.

Anything worthwhile requires hard work, and electronic is no exception. The best way to learn the new material is by reading, thinking and doing. This text is designed to help you along the way by providing an outline and objectives for each chapter, numerous worked-out examples and tutorial questions.

Don't expect everything to be crystal clear after a single reading. Read each article of the text carefully and think about what you have read. Work through the example problems step by step before trying the tutorial problems. Sometimes more than one reading of the article will be necessary. Review the chapter summary. Take the multiple choice questions and work the problems at the end of the chapter.

Although every care has been taken to check mistakes and misprints, yet it is very difficult to claim perfection. Any errors, omissions and suggestions for the improvement of this book, brought to my notice will be thankfully acknowledged and incorporated in the next edition.

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CONTENTS

1 CHAPTER

Introduction

OUTLINE

Objectives

After completing this chapter, you should be able to:

- Known the definition of electronics
- Descirbe applications of electronics in the field of communication, defense, industry and medicine
- Identify different electronic design automation (EDA) tools for designing and simulating electronic circuits.

1-1. Definition

Let us first begin our study about what is engineering is the science of transforming knowledge in physics, chemistry, and mathamatics into products and system that meet the needs and wants of everyday life.

A physicist may have a knowledge of the contribustion cycle, but it is the engineer who builds the car. A chemist may have discovered the properties of silicon, but it is the engineer who produces the micro-processor chip. A Mathematical may have invented Fast Fourier Transform. but again it is the engineer who designed the DVD player.

Electronics is the field of science and technology that deals with the behaviour of electric currents in electronic devices, components, system or equipment. The electronic device, component, system or equipment could be carry thing raging from lasers, photo cells, transistor, micro-processors, microcontrollers, robots, CD-player, DVD, mobile telephones, fax machines, the Internet, computers, high definition plasma television, disk drives digital camera, camcorder, MP3 player, mobile phones etc.

These days, the field of electronics has become the most important branch of engineering in our society. Several thousand developments have taken place in the last country especially in the past five decodes., You name of the item and it has an electronic circuit inside. The electronic devices and gadgets are being used in almost all industries for manufacturing inspection, quality check, control and automation of industrial process, fixed mobile communication, computer networks, Internet and so on. Because of the tremendous growth of electronics and ever growing applications

of electronics in almost all fields, the students of all engineering disciplines (computer engineering, information technology, electrical engineering, mechanical production engineering, machatronics) have to be taught electronics at undergraduate level.

1–2. Beginning and Development of Electronics

The era of electronics is believed to have dawned with the experiments involving electric currents in glass vacuum tubes. Such experiments were performed around 1850 by a German scientist named Geissler. He found that if the air is removed from a glass tube, it glows when an electric current passes through it. Around 1878, British scientist, Sir William Crookes found that the current in vacuum tubes seemed to consist of particles.

As a matter of fact, the electron was discovered in the 1890's. A French physicist, Perrin demonstrated that current in a vacuum tube consists of the movement of negatively charged particles in a given direction. Some of the properties of these particles were measured by a British physicist Thomson. These negatively charged particles were later on, named as electrons. An American physicist, Milikan, in 1909 measured the charge on an electron. As a result of these discoveries, the movement of electrons could be controlled, and thus the electron era started.

Fleming, in 1904, invented a vacuum tube that allowed electrical current only in one direction. This tube was named as Fleming valve or diode vacuum tube and used to detect electromagnetic waves. In 1907, Lee deForest, an American scientist invented a tube, which could amplify weak electrical a.c. signals. This tube was named as triode vacuum tube.

Around 1915, few great improvements were made in the triode vacuum tube. It was used in oscillator circuit. It was also used in telephone system, which made possible the communication between the different continents. The tetrode was invented in 1916 by a German engineer and a pentode was invented in 1926 by a Dutch engineer. The tetrode, alongwith the pentode, greatly improved the triode. The first television picture tube, called the kinescope, was developed in 1920's by an American researcher.

Several types of microwave tubes were developed during the World War II. Such tubes made the modern RADAR and other communication systems possible. The magnetron was invented in Britain in 1939. In the same year, klystron microwave tube was developed by two Americans. The travelling wave tube (TWT) was invented in 1943 by an American scientist.

The era of solid state electronics began with the invention of transistor in 1947 at Bell laboratory. The inventors were Walter Britain, John Bardeen and William Shockley. The transistors were produced commercially in 1951. The companies like RCA, Raythesn, General Electric, Westinghouse and Western Electric were the first to fabricate transistors.

In 1958, it was thought that germanium and silicon can be used to build an entire circuit, called monolithic circuit. Resistors were formed with the bulk semiconductor or by diffusing one semiconductor into another. The capacitors were formed by using a metallic layer and the semiconductor for the plates and an oxide layer for the dielectric. In 1959, Noyce gave an idea for making multiple devices on a single piece of silicon, in order to make an interconnection between devices as part of manufacturing process. It could reduce the size, weight and cost per device. The monolithic-circuit was named an integrated circuit (IC). The IC's were produced, commercially in 1961 by Fairchild and Texas instruments.

1-3. Modern Trends in Eletronics

The development of an integrated circuit (IC) in 1961 was a great achievement in the field of electronics. But, as there is no end to the man's desire, the growth accelerated further every year. Rapid developments have been made in the integrated circuit technology. Thus starting from the *small-scale integration (SSI) in 1961, then **medium-scale integration (MSI) in 1966, and †large-

* It indicates that the number of components fabricated on a single-chip was less than 100.

** It indicates that the number of components fabricated on a single-chip was 100 to 1000.

† It indicates that number of components fabricated on a single-chip is between 1000 to 10,000.

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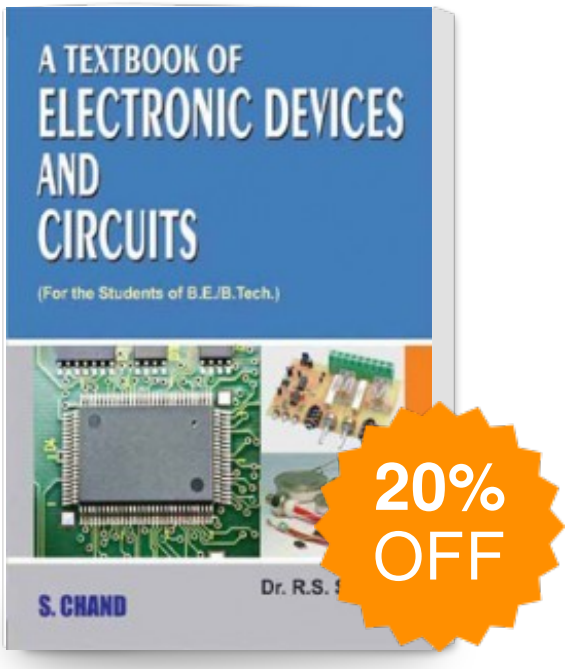

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