Fundamentals of Electrical and Electronic Design

FORTH EDITION

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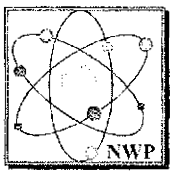

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Preface

Everyone is aware of the electronics revolution that is taking place in the industrialised world. Today, electronics pervades all activities. Not too long ago home electronics meant little more than the radio; next came television and high fidelity. Then, suddenly, there appeared calculators, TV games, home computers, electronic ignitions, computers built into automobiles, and many others.

The electronic revolution is also taking place in the scientific laboratory and all other workplaces. Today, the preferred method of making almost any kind of measurement is one that involves the use of electronic instruments. There are many reasons for this, including the availability of convenient transducers, the ease of making remote and automatic measurements electronically and, most importantly, the general ease of making precise, accurate electrical measurements. Moreover the introduction of computer control of many processes is speeding up the introduction of all-electronic schemes of measurement into many industrial settings.

This electronic revolution is making it increasingly important for everyone to have at least some understanding of electronics.

I began teaching an introductory electrical network and electronics course at tertiary level a number of years ago. It was my opinion that the advances in modern electrical circuits and solid state electronics had made it possible for students with a reasonably small amount of background knowledge to design and build useful electrical and electronic circuits in modern laboratories.
Over a period of several years, I have taught a tertiary course in which many people have first learned the basics of electrical circuits

and electronics and have then continued on to design, build, and use various circuits in their own research. In the process of teaching this course, I slowly assembled a collection of my own material to supplement the textbooks I used. Eventually, I realised that I had written my own textbook. This is the result.

This book was written to be used in classes designed for students with no background in electrical circuits and electronics or its related areas. Students who already have some knowledge of a topic can quickly skip over what they have already learnt.

I believe that most individuals cannot really learn electrical circuits and electronics without hands-on experience. Electrical networks and electronics are more than just lines on paper; after all, the real goal of electrical networks and electronics is working circuits that do things, not just exist as diagrams. A very large amount of learning takes place while a student is struggling to make a simple circuit work.

This book is intended as a teaching text for the subjects which are involved with fundamentals of electrical circuits and electronics. It therefore contains a structure and is written in a style which is designed to help students to better understand the basic principles of those subjects and to design a range of electrical and electronic circuits.

Introduction

This book is an introduction to advanced electrical circuits and modern electronics. The main reason for writing this book is to assist students in learning the basic concepts of advanced electrical circuits and modern electronics and to do it in such a way that students can continue to learn additional electrical circuits and electronics on their own.

Although the field of electrical circuits and electronics is changing, the fundamental laws describing the operation of electrical circuits and electronic devices and the methods of analysis used to understand electrical and electronic circuits, change slowly, if at all.

The purpose of this book is to prepare students to be able to read the current literature in the field of electrical circuits and electronics and to be able to learn more electrical circuits and electronics on their own. The goal of teaching students how to learn on their own is, after all, what higher education is all about.

A good working knowledge of electrical circuits and electronics has four elements.

The first element is knowledge of the basic physical laws that apply to the operation of electrical circuits and electronics. This includes the basic circuit analysis laws as well as the laws that describe solid state physics.

The second element is the knowledge of circuit analysis techniques, which are the mathematical techniques that are used to understand the operation of circuits.

The third element is knowledge of the state of the art in electrical circuits and electronics. This includes the answer to questions such as, "How do I build a power supply or an electronic counter". The answers to such questions define what is called the state of the art at any given time.

The fourth element is a mastery of the vocabulary. Electronic literature is filled with specialised vocabulary. The literature cannot be read by someone who does not have a fair mastery of the vocabulary. This vocabulary does not change very rapidly. New terms are occasionally introduced, but mainly old ones are used in new situations.

My approach to teaching electrical networks and electronics is to provide a balanced approach to these four elements.

The design of this book

There are two problems that must be solved in the design of a good electrical circuits and electronics course. First, each of us has a different set of professional goals, personal interests, and level of preparation. Thus no single course design will suit everyone.

Second, electrical circuits and electronics is a very complex subject, we cannot master it in one examination of available material. Even more importantly, efficient learning requires time, motivation, and active participation.

Some Advice on how to study the subject of electrical circuits and electronics

No one can learn electrical circuits and electronics all at once. Gaining a reasonable knowledge of these requires going back over the material several times. Only time and repetition will give us a solid knowledge of the material. Of course, this is no different from anything else we try to learn. Repetition or review is crucial in any learning situation.