

Preface

The pervasive presence of electronic devices and instrumentation in all aspects of engineering design and analysis is one of the manifestations of the electronic revolution that has characterized the second half of the 20th century. Every aspect of engineering practice, and even of everyday life, has been affected in some way or another by electrical and electronic devices and instruments. Computers are perhaps the most obvious manifestations of this presence. However, many other areas of electrical engineering are also important to the practicing engineer, from mechanical and industrial engineering, to chemical, nuclear, and materials engineering, to the aerospace and astronomical disciplines, to civil and the emerging field of biomedical engineering. Engineers today must be able to communicate effectively within the interdisciplinary teams in which they work.

OBJECTIVES

The objectives of this book have not changed since work started on the first edition in 1987. On the contrary, engineering education and engineering professional practice have seen some rather profound changes in the past decade. The integration of electronics and computer technologies in all engineering academic disciplines and the emergence of digital electronics and microcomputers as a central element of many engineering products and processes have become a common theme.

The principal objective of the book is to present the *principles* of electrical, electronic, and electromechanical engineering to an audience composed of non-electrical engineering majors, and ranging from sophomore students in their first required introductory electrical engineering course, to seniors, to first-year graduate students enrolled in more specialized courses in electronics, electromechanics, and mechatronics.

A second objective is to present these principles by focusing on the important results and applications and presenting the students with the most appropriate *analytical and computational tools* to solve a variety of practical problems.

Finally, a third objective of the book is to illustrate, by way of concrete, fully worked examples, a number of relevant *applications* of electrical engineering principles. These examples are drawn from the author's industrial research experience and from ideas contributed by practicing engineers and industrial partners.

The three objectives listed above are met through the use of a number of new features, affecting the pedagogy and content of this book. The next two sections of this preface describe the organization of the book and the major changes that have been implemented in this fourth edition.

ORGANIZATION AND CONTENT

The organization of the book is nearly unchanged in its basic elements: the book is divided into three parts, devoted to *circuits*, *electronics*, and *electromechanics*. Changes in the contents are described next.

Part I: Circuits

Part I on circuits has been revised extensively, to acknowledge the many valuable suggestions made by users of the previous editions. In addition to the revision of all the examples, and the addition or substitution of a number of examples, approximately 200 new homework problems are supplied for this part. Chapters 2 and 3 have been revised

substantially, to incorporate numerous pedagogical improvements and to enhance the clarity and organization. Chapters 4 (on AC circuit analysis), 5 (on transient analysis), and 6 (frequency response) have seen very significant revisions, which, in addition to improving the organization of the material, makes it possible for instructors to choose either the subject of *transient analysis* or the subject of *phasor analysis* as the preferred topic to follow the network analysis topics of Chapter 3. The book was originally written to reflect this author's preference to introduce phasor notation and AC circuit analysis immediately following DC circuit analysis; this fourth edition is still organized according to this principle. However, an equally valid approach (probably more formally correct, but a little less efficient when time is a constraint) is first to introduce transient analysis and then to present phasor analysis as a special case. In this fourth edition, the latter approach can be taken by following the second path of Figure 1. Sections 4.1 and 4.2 introduce the topics of energy storage elements and of time-dependent signals. Section 4.3 shows that differential equations result when the basic circuit laws are applied to circuits containing inductors and capacitors. This brief introduction leads directly to Chapter 5, which covers first- and second-order circuit transient analysis. Chapter 5 is also modular in that the instructor may easily choose to cover only first-order transients. Chapter 6 has also been revised, with the addition of more complete material on Fourier series and Bode plots; the brief section on the Laplace transform has been moved to Appendix B.

Figure 1 also depicts a number of other possible paths that can be taken to develop a customized course syllabus, showing that the placement of the chapters on frequency response (6) and AC power (7) is very flexible. Either Chapter 6 or Chapter 7 could be covered immediately following Chapter 4.

Finally, the material on operational amplifiers has been moved to Chapter 8, and it can be easily integrated into any syllabus for a first course in electrical engineering (EE). Sections 8.1 and 8.2 can be covered immediately following Chapter 3, treating the op-amp as a circuit element; the rest of the chapter is most appropriately introduced after completion of Chapter 6.

Part II: Electronics

Part II on electronics has also seen some major revisions. First, the chapter on operational amplifiers has been moved to be the opening chapter of the section. Op-amps are the most common topic found in introductory EE courses that cover electronics and, as mentioned in the preceding section, is often a topic selected for coverage in electric circuit courses. The instructor interested in a coverage of integrated circuits and systems can follow an *integrated-circuits track*, which leads to the chapters on digital logic circuits and systems (13 and 14) and to the chapter on instrumentation (15). These chapters have only seen minor revisions relative to the third edition.

Instructors who wish to cover discrete devices will find significantly revised material in Chapters 9 through 12, leading to the *discrete devices track*. Chapter 9, covering semiconductors and diodes, has seen relatively few changes, while Chapters 10 (bipolar transistors) and 11 (field-effect transistors) are new. Each of these two chapters focuses on one of the two major transistor technologies, and the two chapters are functionally independent (i.e., it is possible to cover just one of the two, or the order of coverage can be reversed). Further, each of the transistor chapters covers both linear amplifier and switching applications. The material on small-signal amplifier design (Chapter 12 in the third edition) has been largely eliminated in recognition of the evolving nature of integrated-circuit electronics, and of the very small likelihood of a non-electrical engineer being involved in the design of discrete transistor amplifiers. Last, Chapter 12, covering power electronics, has only seen minor revisions.

An example of a *mixed analog-digital track* is also shown in Figure 2. Of course, individual instructors will find other creative ways to use the material in the electronics section.

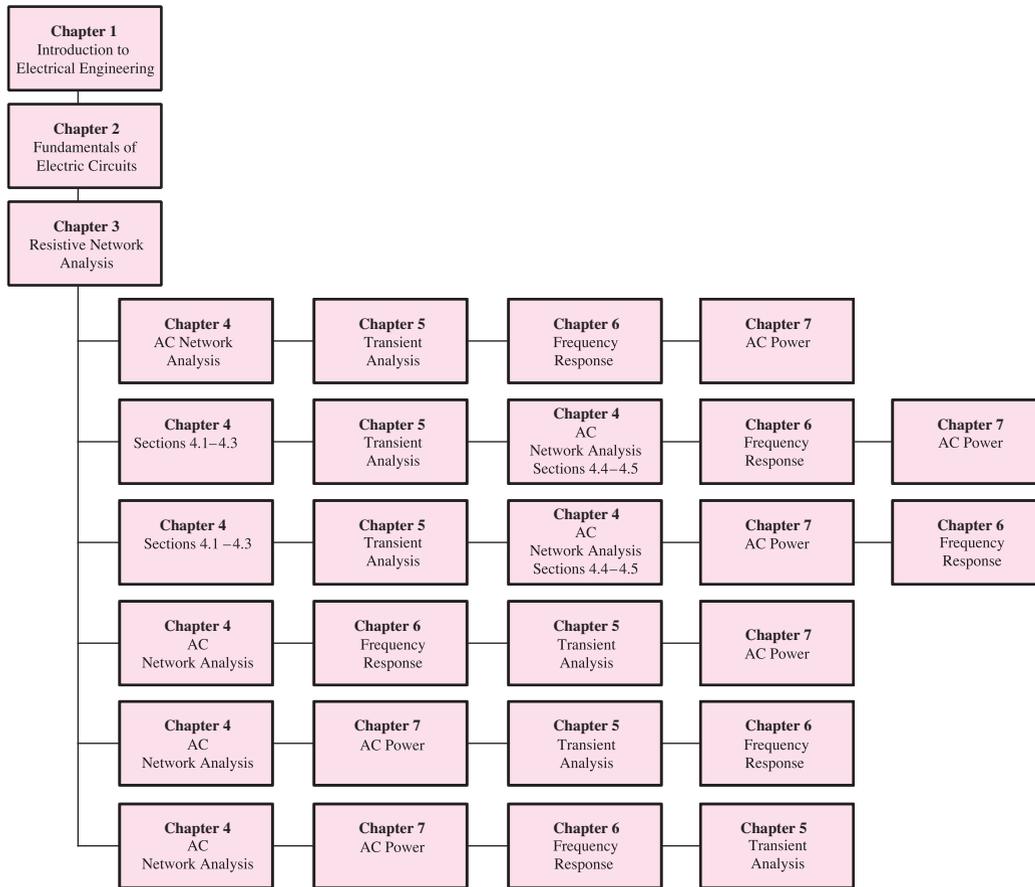


Figure 1 Modular options in Part I on circuits

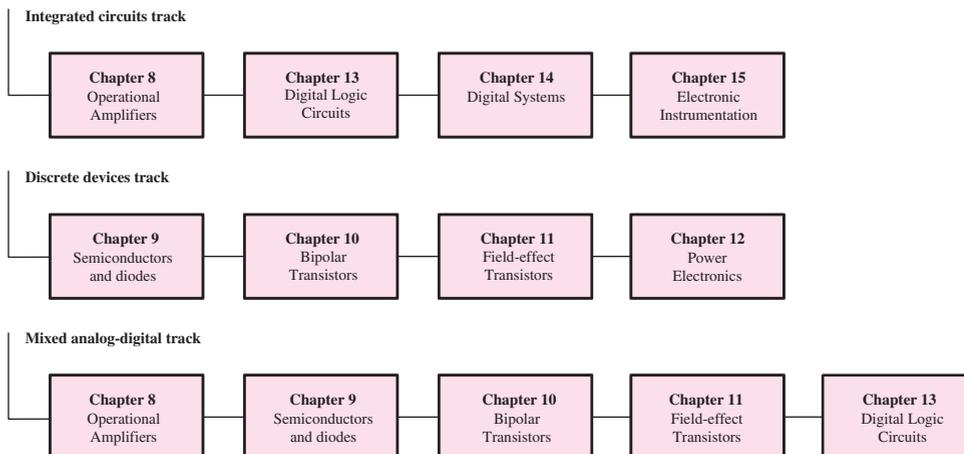


Figure 2 Modular options in Part II on electronics

Part III: Electromechanics

Part III on Electromechanics has been revised for accuracy and pedagogy, but its contents are largely unchanged. This part has been used for many years by the author as a supplement in a junior-year “System Dynamics” course for mechanical engineers. It lends itself quite nicely to a second course in power systems when coupled with earlier chapters on AC power and on electronics, as shown in Figure 3.

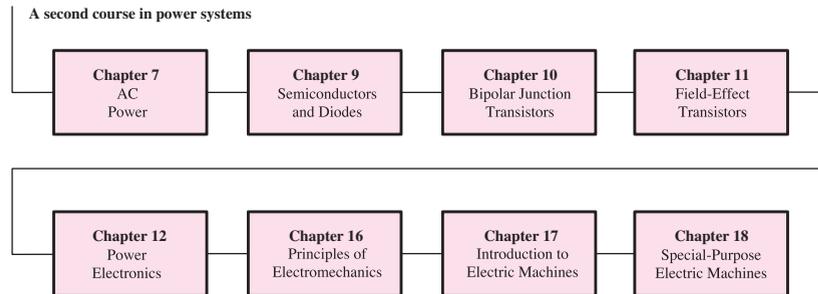


Figure 3 A second course in power systems



Instructors will find additional suggestions on the organization of course materials at the book’s website <http://www.mhhe.com/engcs/electrical/rizzoni>. Suggestions and sample curricula from users of the book are welcome!

CHANGES IN THE FOURTH EDITION

Pedagogy

While most of the features of the third edition have been retained, some key improvements have been made in the pedagogy.

- A list of **Learning Objectives** is given at the beginning of each chapter, and direct reference to each learning objective is made when important definitions, results, and examples relevant to a learning objective are presented.
- **Make the Connection** sidebars are used to present analogies between electric circuits and hydraulic, thermal, and mechanical systems. Examples that illustrate the analogies are included.
- Most examples are followed by one or more **Check Your Understanding** exercises; in the fourth edition, the answer is printed upside-down immediately following the example.
- Approximately 300 new homework problems have been supplied. Two-thirds of the new problems are in Part I on circuits. The homework problems have been reorganized in sections that directly correspond to the sections in each chapter.
- Several new **Focus on Methodology** boxes have been added throughout the book.
- The **flow** and **continuity** of the text have been improved throughout the book, and the text has been edited for **conciseness**.

Supplements

The book includes a wealth of supplements, many available in electronic form. These include

- A website that will be dynamically updated to provide students and instructors with instructor notes, additional examples, suggestions for the use of the book, a forum for discussion, and other features. The URL is <http://www.mhhe.com/rizzoni>.
- A chapter on electrical communications for schools that teach this subject in their curriculum.
- A completely revised Solutions Manual, available in both paper and electronic form.
- PowerPoint presentation slides of important figures, available on the Online Learning Center.
- Transparency masters of important figures.



Online Learning Center

This book has an Online Learning Center, hosted on the McGraw-Hill website at <http://www.mhhe.com/rizzoni>. Instructors using the text can access a special curriculum-based threaded discussion list within the Online Learning Center Resources available are

- PowerPoint presentation slides of important figures from the text.
- A course website builder called Page Out. Instructors can quickly build a course website by entering basic information into McGraw-Hill's Page Out interface.
- Additional support for the CD-ROM that accompanies the text. The goal of the Online Learning Center is to provide full-service instructor and course management support for those who request it.
- An Instructor's Solutions Manual with complete solutions to all homework problems.
- Chapter 19, Introduction to Communication Systems, for further study.
- Sample syllabi.
- Data sheets for devices mentioned in the text.
- Instrumentation Examples provided courtesy of Hewlett-Packard Company.
- *Find It on the Web* links give students the opportunity to explore, in greater depth, practical engineering applications of the devices and systems that are described in the text. In addition, several links to tutorial sites extend the boundaries of the text.



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After three prefaces, it is easy to sound stale in recognizing the role played by an author's spouse in the success of such a major project. My love and admiration for my wife, Kathryn, have only grown through the years. I am deeply grateful to her for always being available to support me, and for being such a great companion. Each of the first three editions of this book has been indelibly marked by the birth of one of our three children. This time no baby is on the horizon, so I take this opportunity to dedicate this book to Alessandro, Maria, and Michael, who are truly the joy of our life.