

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 astronautical 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

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 over the nearly 20 years since the conception of this book.

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 pedagogical features. 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 book is divided into three parts, devoted to *circuits*, *electronics*, and *electromechanics*. Changes in the contents are described next.

Part I: Circuits

The first part of the book remains essentially unchanged, after the significant revisions brought by the fourth edition. The only major change is the addition of approximately 110 new homework problems.

Part: II Electronics

Part II, on electronics, presents some new features in the treatment of transistors. Chapter 10, on bipolar transistors, and Chapter 11, on field-effect transistors, have been significantly reorganized to focus on the use of these devices in simple but useful circuits. Modeling emphasis is limited to large-signal models, which are sufficient for the intended purpose. New examples include the design of simple electric motor drivers and of battery chargers. These two chapters now present a new, uncomplicated, and practical treatment of the analysis and design of simple amplifiers and switching circuits using large-signal models. The revisions were based on a conscious decision to completely eliminate all of the material related to small-signal models of amplifiers. Chapter 12, on power electronics, includes two new examples describing power stage amplifier characteristics. The remainder of the electronics section, Chapters 8 and 9, and 13, 14, and 15, are mostly unchanged, except for the addition of a handful of new application-oriented examples. Nearly 100 new homework problems have been added to Part II.

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. The chapters include some New examples and approximately 20 new problems.

New in the fifth edition is the inclusion of two chapters on communications. These chapters have been added at the request of numerous schools, where it is felt that a modern engineer needs to have exposure to basic principles of communication systems. Chapter 16 is a revised edition of the an analog communications chapter that has been available on the book website since the third edition. The intent of the chapter is to present the basic principles of analog communications systems, leading to a basic understanding of analog AM and FM systems. Chapter 17, courtesy of Dr. Michael Carr, of the Ohio State University ElectroScience Laboratory, introduces the basic principles of digital communications systems. Both chapters focus on applications.

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



FEATURES OF THE FIFTH EDITION

Pedagogy

The fifth edition continues to offer all of the time-tested pedagogical features available in the earlier editions.

- **Learning Objectives** offer an overview of key chapter ideas. Each chapter opens with a list of major objectives, and throughout the chapter the learning objective icon indicates targeted references to each objective.

- **Focus on Methodology** sections summarize important methods and procedures for the solution of common problems and assist the student in developing a methodical approach to problem solving.
- **Clearly Illustrated Examples** illustrate relevant applications of electrical engineering principles. The examples are fully integrated with the “Focus on Methodology” material, and each one is organized according to a prescribed set logical steps.
- **Check Your Understanding** exercises follow each example in the text and allow students to confirm their mastery of concepts.
- **Make the Connection** sidebars present analogies to students to help them see the connection of electrical engineering concepts to other engineering disciplines.
- **Focus on Measurements** boxes emphasize the great relevance of electrical engineering to the science and practice of measurements.
- **Find It on the Web** links included throughout the book give students the opportunity to further explore practical engineering applications of the devices and systems that are described in the text.

Supplements

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

- A **CD-ROM** containing computer-aided example solutions, a list of Web references for further research, device data sheets, Hewlett-Packard Instrumentation examples, and a motor control tutorial.
- A **website** (Online Learning Center) will be updated to provide students and instructors with additional resources for teaching and learning. You can find this site at <http://www.mhhe.com/rizzoni>



Online Learning Center

(<http://www.mhhe.com/rizzoni>)

Resources on this site include:

For Students:

- **Algorithmic Problems** that allow step-by-step problem-solving using a recursive computational procedure to create an infinite number of problems.
- **Device Data Sheets**
- **Hewlett-Packard Instrumentation Examples**
- A **Motor Control Tutorial**, and more...

For Instructors:

- **PowerPoint presentation slides** of important figures from the text
- **Instructor's Solutions Manual** with complete solutions (for instructors only)
- **COSMOS** (Complete Online Solutions Manual Organizing System)
- **MATLAB** Solution files for selected problems

For Instructors and Students:



- **Find It on the Web links**, which 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 recent research developments, late-breaking science and technology news, learning resources, and study guides to help you in your studies and research
- **News feeds** provide current daily news from *The New York Times* and other reliable online news resources related to the topics in the text. While most students and instructors have access to current news online, these feeds are selected based on the topics presented in each chapter of Rizzon's text.

ACKNOWLEDGMENTS

This edition of the book requires a special acknowledgment for the effort put forth by my friend Tom Hartley of the University of Akron, who has become a mentor, coach, and inspiration for me throughout this project. Professor Hartley, who is an extraordinary teacher and a devoted user of this book, has been closely involved in the development of the fifth edition by suggesting topics for new examples and exercises, creating new homework problems, providing advice and coaching through all of the revisions, and sometimes just by lifting my spirits. I look forward to many more years of such collaborations.

I would also like to recognize the focused effort of Dr. Michael Carr, of the Ohio State University ElectroScience Laboratory, who is responsible for creating Chapter 17 on Digital Communications. His efforts and the assistance provided by graduate students Adam Margetts and Aditi Kothiyal are very much appreciated.

This book has been critically reviewed by the following people.

- Ravel Ammerman, Colorado School of Mines
- Glen Archer, Michigan Technological University
- Ray Bellem, Embry-Riddle Aeronautical University
- Keith Burgers, University of Arkansas

- Doroteo Chaverria, University of Texas—San Antonio
- Randy Collins, Clemson University
- Marcelo J. Dapino, The Ohio State University
- Alexandros Eleftheriadis, Columbia University
- Otto M. Friedrich, University of Texas—Austin
- Takis Kasparis, University of Central Florida
- Rasool Kenarangui, University of Texas—Arlington
- Andy Mayers, Penn State University
- Nathan Shenck, U.S. Naval Academy
- Dr. B. J. Shrestha, University of Missouri—Rolla
- Miklos N. Szilagyi, University of Arizona
- Albert H. Titus, SUNY Buffalo
- Trac D. Tran, Johns Hopkins University

In addition, I would like to thank the many colleagues who have pointed out errors and inconsistencies in the fourth edition. We have gladly accepted all of their suggestions. The following is a partial list of those who have contributed to improving the accuracy of this book.

- Suresh Kumar R., Amrita School of Engineering, India
- Thomas Schubert, University of San Diego
- T. S. Liu, Professor, Chiao Tung University, Taiwan
- Mohan Krishnan, University of Detroit Mercy
- Stephen Deese
- Rony Shahidain

The author is also grateful to Mr. David Mikesell and Mr. Qi Ma, graduate students at Ohio State, for help and advice.

Book prefaces have a way of marking the passage of time. When the first edition of this book was published, the birth of our first child, Alex, was nearing. Each of the following two editions was similarly accompanied by the births of Maria and Michael. Now that we have successfully reached the fifth edition (but only the third child) I am observing that Alex is beginning to understand some of the principles exposed in this book through his passion for the FIRST Lego League and the Lego Mindstorms robots. Through the years, our family continues to be the center of my life, and I am grateful to Kathryn, Alessandro, Maria, and Michael for all their love.