

Dedicated to

our families

especially

Chris

2002

PREFACE

Features

The main objectives of the book remains the same as in the first edition - to present circuit analysis in a manner that is clearer, more interesting, and easier to understand than earlier texts. This objective is achieved in the following ways:

- A course in circuit analysis is perhaps the first exposure students have to electrical engineering. We have included several features to help students feel at home with the subject. Each chapter opens with either historical sketches of some electrical engineering pioneers to be mentioned in the chapter or a career talk on a subdiscipline of electrical engineering. This is followed by an introduction that links the chapter with the previous chapters and states the chapter objectives. The chapter ends with a summary of the key points and formulas.
- Problem solving is discussed in chapter one to promote sound, step-by-step problem solving practices. A bookmark is included with each copy of the book to remind students of the solution steps (and to mark their place).
- All principles are presented in a lucid, logical, step-by-step manner. As much as possible, we avoid wordiness and giving too much detail that could hide concepts and impede overall understanding of the material.
- Important formulas are boxed as a means of helping students sort what is essential from what is not. Also, to ensure that students clearly get the gist of the matter, key terms are defined and highlighted.
- Marginal notes are used as pedagogical aid. They serve multiple uses such as hints, cross-references, more exposition, warnings, reminders not to make some particular common mistakes, and problem solving insights.
- Thoroughly worked examples are liberally given at the end of every section. The examples are regarded as part of the text and are clearly explained without asking the reader to fill in missing steps. Thoroughly worked examples give students a good understanding of the solution and the confidence to solve problems themselves. Some of the problems are solved in two or three ways to facilitate an understanding and comparison of different approaches.
- To give students practice opportunity, each illustrative example is immediately followed by a Practice Problem with the answer. The students can follow the example step-by-step to solve the Practice Problem without flipping pages or looking at the end of the book for answers. The Practice Problem is also intended to test if students understand the preceding example. It will reinforce their grasp of the material before moving to the next section.
- The last section in each chapter is devoted to application aspects of the concepts covered in the chapter. The material covered in the chapter is applied to at least one or two practical problems or devices. This helps the students see how the concepts are applied to real-life situations.

- Ten review questions in the form of multiple-choice objective items are provided at the end of each chapter with answers. The review questions are intended to cover the little "tricks" which the examples and end-of-chapter problems may not cover. They serve as a self-test device and help the students determine how well they have mastered the chapter.
- The end-of-chapter homework problems (as well as the solutions available at the website for instructors only) have been thoroughly checked for accuracy. There are approximately 25% new problems in this edition.
- In recognition of ABET's requirement on integrating computer tools, the use of *PSpice* is encouraged in a student-friendly manner. Since the window version of *PSpice* is becoming popular, it is used throughout instead of the MS-DOS version of *PSpice*. *PSpice* is covered early in the text so that students can become familiar and use it throughout the text. Appendix D serves as a tutorial on *PSpice* for Windows.
- The operational amplifier (op amp) as a basic element is introduced early in the text.
- To ease the transition between the circuit course and signals/systems courses, Fourier and Laplace transforms are covered lucidly and thoroughly.

Organization

This book was written for a two-semester or three-quarter course in linear circuit analysis. The book may also be used for a one-semester course by a proper selection of chapters and sections by the instructor. It is broadly divided into three parts.

- Part 1, consisting of chapters 1 to 8, is devoted to dc circuits. It covers the fundamental laws and theorems, circuit techniques, passive and active elements.
- Part 2, which contains chapters 9 to 14, deals with ac circuits. It introduces phasors, sinusoidal steady state analysis, ac power, rms values, three-phase systems, and frequency response.
- Part 3, consisting of chapters 15 to 19, is devoted to advanced techniques for network analysis. It provides students with a solid introduction to the Laplace transform, Fourier series, the Fourier transform, and two-port network analysis. The material in three parts is more than sufficient for a two-semester course so that the instructor must select which chapters/sections to cover. Sections marked with the dagger sign (??) may be skipped, explained briefly, or assigned as homework. They can be omitted without loss of continuity. Each chapter has plenty of problems grouped according to the sections of the related material and so diverse that the instructor can choose some as examples and assign some as homework. More difficult problems are marked with star (*). Comprehensive problems appear at the end of the end-of-chapter problems. They are mostly applications problems which require skills learned from that particular chapter.

In this edition, a new chapter (chapter 16) has been added to augment chapter 15 on the Laplace transform. This expansion of analysis in the s-domain reflects the importance of the frequency domain in helping the student to fully understand circuits. A new appendix (appendix E) has been added to provide a tutorial on *MATLAB* and encourage its usage in circuit analysis. In addition, several chapters now include problems to be solved using *MATLAB*. Appendix D on *PSpice* has been upgraded. All the errors in the first edition have been corrected and every effort has been made to make this edition as error-free as possible.

Prerequisites

As with most introductory circuit courses, the main prerequisites, for a course using the text, are physics and calculus. Although familiarity with complex numbers is helpful in the later part of the book, it is not required.

Supplements

Student CD-ROM – The CD-ROM from the first edition has been upgraded to include the following: MultSIM 2001 Textbook Edition from Electronics Workbench and more than 125 circuit files from the book presented in the *MultiSim* software. Multisim 2001, the latest release of the Electronics Workbench flagship product, delivers intuitive schematic capture, accurate simulation and analysis, along with programmable logic. It provides industry-leading power with all of the features and functionality instructors demand in an easy-to-learn and easy-to-use package. Students can create circuits, analyze pre-built circuits, work through virtual laboratory assignments, simulate circuit behavior and troubleshoot for faults. Teachers can customize their circuits using Multisim’s powerful “Teacher Features” including the ability to build faulted components into a circuit and to password protect access to components, instruments and analyses.

Problem Solving Made *Almost Easy* – *A Companion to Alexander/Sadiku's Fundamentals of Electric Circuits*-- This workbook is for sale to students who wish to practice their problem solving techniques. The workbook contains a discussion of problem solving strategies and 150 additional problems with complete solutions provided.

Online Learning Center (OLC) – The Online Learning Center, which provides material for students and instructors, has been upgraded to include the following: updated solutions manual for instructors only, updated and new PowerPoint slides, updated web links, updated network analysis tutorials, sample pages from the companion workbook, quizzes, learning objectives, and flashcards. More information can be found at www.mhhe.com/alexander2.

Although the textbook is meant to be self-explanatory and act as a tutor for the student, the personal contact in teaching is not forgotten. It is hoped that the book supplies the instructor with all the pedagogical tools necessary to effectively present the material.

ACKNOWLEDGMENT

We would like to thank editorial and production staff of McGraw-Hill for being one of the most professional staffs with whom we have worked! In particular, Kelly Butcher, Sr. Developmental Editor, Catherine Fields Shultz, Sponsoring Editor, Michelle Flomenhoft, Developmental Editor II, and Jane Mohr, Project Manager, have been very helpful and patient.

Thanks also to the following:

Publisher: Betsy Jones
Senior Sponsoring Editor: Carlise Paulson
Marketing Manager: John Wannemacher

Media Producer: Phillip Meek
Production Supervisor: Sherry Kane
Designer: Rick Noel
Photo Research: Carrie Burger
Media Project Manager: Jodi Banowetz

This edition has benefited from the insightful comments of the following reviewers (alphabetical order):

Mohamed K. Darwish, Brunel University (United Kingdom)
Kevin D. Donahue, University of Kentucky
Gary K. Fedder, Carnegie Mellon University
Cynthia J. Finelli, Kettering University
William K. Kennedy, University of Canterbury (New Zealand)
Bin-Da Liu, National Cheng Kung University (Taiwan)
Damon Miller, Western Michigan University
Ahmad Nafisi, California Polytechnic State University, San Luis Obispo
Hadi Saadat, Milwaukee School of Engineering
Promod Vohra, Northern Illinois University

Finally, we are particularly indebted to those instructors and students who used the first edition and took the time to point out errors in that edition. We wish to continue this important spirit, please keep sending those emails. We can be reached at c.alexander@ieee.org for Charles Alexander and sadiku@ieee.org for Matthew Sadiku. (or Direct them to the publisher.)

On a personal note, Matthew and I would like to express our appreciation for the loving support we have received wives (Chris and Hannah) daughters (Ann, Joyce, Christina, Tamara, and Jennifer), son (Baixi), our parents (Ayisat and Solomon Sadiku and Ken and June Alexander), and our extended families.

Unfortunately, Matthew's loving and supportive wife, Chris, passed away during the spring of 2002. It was a tragic loss of a wife, mother of Ann and Joyce, friend, valued companion, and blessed person. She will be missed. On behalf of Matthew, I would like to extend our appreciation for the care and support he and his daughters have received during a very difficult period.

C.K. Alexander and M. N. O. Sadiku