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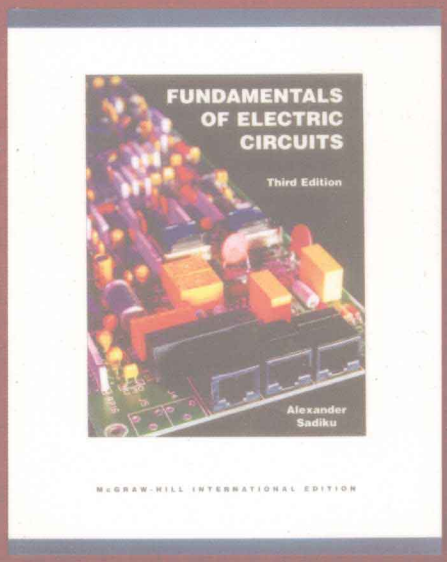

（双语版）

电路基础（第3版）

Fundamentals of Electric Circuits

(Third Edition)

原著

Charles K. Alexander

Matthew N. O. Sadiku

于歆杰 等 选译

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Fundamentals of Electric Circuits
（第3版）

双语版前言

由 C. K. Alexander 和 M. N. O. Sadiku 合著的《电路基础》是一本为电类各专业大学生学习电路课程而编写的教科书。该书于 2000 年由 McGraw-Hill 公司出版第 1 版，于 2007 年出版第 3 版，本书是该书第 3 版的双语本。

这本书讲述的是电路课程的基础知识，它大致可以分为以下 3 个部分：(1)直流电路，基本定律和定理，无源元件，有源元件；(2)交流电路，相量，正弦稳态分析，功率，有效值，三相电路，频率响应；(3)拉普拉斯变换，傅里叶级数，傅里叶变换，二端口网络分析。由此可以看出，它对基本内容的选取与当前国内外许多高等学校对该课程内容的取舍大体一致。有些列入电路课程及其教材的内容，如网络图论基础、非线性电路等，此书均不涉及，这更加突出了此教材的基础性质，避免了与后续课程可能有的重复。

这本电路教科书以电路的基础知识、分析方法为主体，编著者在此基础上适当地做了有创意的延伸与发展，加强了它与新技术的联系。例如：将运算放大器作为一个基本电路元件引入，并在全书中使用；从电路中的谐振现象开始进入频率特性、滤波器电路的分析；晶体管的电路模型、模拟计算机的概念、稳定性的概念、采样定理等的引入，都有着这样的作用。这些内容对于电类专业的学生而言，其重要性是不言而喻的，能够使学生在开始学习电路课程时就建立起各种概念，这不仅对学习电路课，而且对学习后续课、开阔学习思路都是有益的。

在教学方法上，编著者在书中作了许多精心安排，这形成了此书的明显特色。全书的讲述明白易懂，推理严格清晰；每章的开始处都有一段题为“增强技能与拓展事业”的文字，书中有电工发展历史上若干名人事迹的介绍，这些内容可以使读者从不同的侧面得到有益的启示；书中有许多解答详细的例题和大量多种类型的习题，每章末的习题平均有 80 多道，这对学生逐步深入掌握课程内容，增强灵活运用电路知识的能力，有着积极的引导作用；书中有对计算机辅助电路分析的介绍，这包括对 PSpice、MATLAB 以及较新的电路分析软件 KCIDE 的使用方法的说明，各章中都有许多指明要用某程序求解的电路习题，可用于对学生进行相应的训练；每章的最后一节都研究该章中涉及的一些概念的应用，通常是讨论一两个实际问题或器件，有助于学生了解这些概念是怎样应用于实际的。所有这些使得该书成为一本明白易懂、内容丰富、条理清晰、富有趣味的教科书。

配合该书的使用，McGraw-Hill 出版社还发行了相应的教学辅助软件和光盘，包括教学管理软件、学生解题指导、教师专用光盘等。

除可供电类各专业的大学生做电路课程的教科书使用外，该书亦适合自学者使用，还可供有关技术人员、高校教师参考。

江缉光　教授
清华大学电机工程与应用电子技术系
2008 年 6 月

前　言

特点

从以前版本中保留的特点

本书第3版和以前版本的目标是一样的，即用比其他教材更清晰、更有趣和更容易理解的方式介绍电路分析，并帮助初学者发现工程中的"乐趣"。这个目标是通过下面的方式实现的：

- **每章的导言和小结**

  每章开始都有关于如何提高解题能力的讨论和如何在电气工程的某个学科中取得职业成功或选择职业的讨论。接下来的绪论部分讨论本章和前面几章的关系并介绍本章内容。每章结束时都有关于要点和公式的总结。

- **解题方法**

  第1章介绍了在本书和附加材料中一直使用的求解电路问题的六步法，以促进学生获得良好的解题训练。

- **对学生友好的写作方式**

  所有的原理都以清晰的、逻辑的和一步一步的方式进行介绍。我们尽可能避免冗长的叙述和太多的细节，因为这样可能会喧宾夺主，淡化概念并阻碍学生对内容的全面理解。

- **公式和要点的突出表示**

  重要的公式都用方框框起来，这可以帮助学生把重要的和不重要的区分开来。同时，关键术语都进行了定义并突出地表示出来，这样可便于学生理解。

- **页边空白处的注释**

  页边空白处的注释便于教学。这些注释可能是提示、交叉引用、进一步的说明、警

FEATURES

Retained from Previous Editions

The main objectives of the third edition of this book remain the same as in the first and second editions—to present circuit analysis in a manner that is clearer, more interesting, easier to understand than other texts, and to assist the student in beginning to see the "fun" in engineering. This objective is achieved in the following ways:

- **Chapter Openers and Summaries**
  Each chapter opens with a discussion about how to enhance skills that contribute to successful problem solving as well as successful careers or a career-oriented talk on a sub-discipline 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 key points and formulas.
- **Problem Solving Methodology**
  Chapter 1 introduces a six-step method for solving circuit problems that is used consistently throughout the book and media supplements to promote sound problem solving practices.
- **Student Friendly Writing Style**
  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.
- **Boxed Formulas and Key Terms**
  Important formulas are boxed as a means of helping students sort out what is essential from what is not. Also, to ensure that students clearly understand the key elements of the subject matter, key terms are defined and highlighted.
- **Margin Notes**
  Marginal notes are used as a 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.

- **Worked Examples**
  Thoroughly worked examples are liberally given at the end of every section. The examples are regarded as a 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 process and the confidence to solve problems themselves. Some of the problems are solved in two or three different ways to facilitate a substantial comprehension of the subject material as well as a comparison of different approaches.
- **Practice Problems**
  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 aid in the solution of the practice problem without flipping pages or looking at the end of the book for answers. The practice problem is also intended to test the students understanding of the preceding example. It will reinforce their grasp of the material before they move on to the next section. Complete solutions to the practice problems are available to students on ARIS.
- **Application Sections**
  The last section in each chapter is devoted to practical 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.
- **Review Questions**
  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 students determine how well they have mastered the chapter.
- **Computer Tools**
  In recognition of the requirements by ABET® on integrating computer tools, the use of *PSpice, MATLAB,* and *KCIDE for Circuits* are encouraged in a student-friendly manner. *PSpice* is covered early on 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. *MATLAB* is also introduced early in the book with a tutorial available in Appendix E. *KCIDE for Circuits* is new to this text. It is a brand new, state-of-the-art software system designed to help the student maximize their chance of success in problem solving. It is introduced in Appendix F.
- **Historical Tidbits**
  Historical sketches throughout the text provide profiles of important pioneers and events relevant to the study of electrical engineering.
- **Early Op Amp Discussion**
  The operational amplifier (op amp) as a basic element is introduced early in the text.

告、常见错误的提示或有关解题的思索。

- **解题实例**
  每节最后都给出完整的解题实例。这些例子都是正文的一部分，解释得很清晰，不需要读者做进一步的工作。完整的解题实例使学生很好地理解了求解过程，并且增强了学生解决问题的自信心。有些问题还用2～3种不同方法求解，既有助于增强学生对内容的理解，又可比较不同的方法。
- **练习题**
  每个例子后面都紧跟着一个有答案的练习题。这样可以给学生更多的练习机会。学生可根据例子的求解过程一步一步地练习求解，不用翻页或在书后查找答案。练习题也有助于测试学生对前面例子的理解。及时练习有助于在进入后面内容的学习之前牢固掌握知识。学生可通过ARIS(McGraw-Hill提供的评估复习和指导系统)获得练习题的完整解答。
- **有关应用的节**
  每章的最后一节讨论本章涉及的概念的实际应用。每章讨论的内容至少应用于1个或2个实际问题或设备中。这有助于学生了解概念是如何应用于真实场合的。
- **复习习题**
  每章的最后都用选择题的方式给出了10个复习习题及其答案。复习习题用于覆盖例子和章后问题没有涉及的要点，用于自测并帮助学生了解自己对本章内容的掌握程度。
- **计算机工具**
  工程与技术认证委员会(ABET)要求教学中使用计算机工具，因此本书以轻松的方式讨论了PSpice、MATLAB和KCIDE for Circuits的使用。本书较早地介绍了PSpice，有助于学生尽早熟悉并在学习过程中一直使用。附录D提供了PSpice for Windows的指南。本书还较早地介绍了MATLAB，并通过附录E提供了指南。KCIDE for Circuits是本书新加入的软件。这是个全新的、先进的软件系统，用来帮助学生提高解题的成功率，附录F对该软件进行了介绍。
- **历史珍闻**
  本书介绍了与电气工程相关的重要的先驱和事件的历史梗概。
- **较早地讨论运算放大器**
  作为电路基本元件，较早地讨论了运算放大器。

- **覆盖傅里叶和拉普拉斯变换**
  本书清晰、完整地讨论了傅里叶和拉普拉斯变换。这样可以使学生很容易从电路课程过渡到信号与系统课程。感兴趣的教师可在讲授一阶电路求解后介绍第15章，然后很自然地从拉普拉斯过渡到傅里叶和交流。

- **Fourier and Laplace Transforms Coverage**
  To ease the transition between the circuit course and signals and systems courses, Fourier and Laplace transforms are covered lucidly and thoroughly. The chapters are developed in a manner that the interested instructor can go from solutions of first order circuits to Chapter 15. This then allows a very natural progression from Laplace to Fourier to AC.

本版新的特点

电路分析课程可能是学生第一次接触电气工程。为了使学生熟悉这一课程，我们采取了若干新的措施。

- **4色图文编排**
  对电路图进行了完全的重新设计并用4色图文编排表示，使其更清晰并且改善了教学效果。（注：本双语版采用单色印刷）
- **扩展例子**
  那些根据六步求解法详细演算的例题为学生提供了用统一的方式求解问题的路线图。每章至少有一个例子是这样处理的。
- **符合EC 2000要求的开篇语**
  ABET中关于技能的第3判据，每章的开篇语讨论诸如如何使学生们获得技能，以显著增强他们做为工程师的职业素质这些问题。这些技能对学生的学习和工作都非常重要，因此我们使用的开篇语标题是："增强技能与拓展事业"。
- **课后作业**
  新增了300多道章后习题，为学生提供了充分的练习和加强概念的机会。
- **课后作业图标**
  与工程设计有关的问题和可用PSpice或MATLAB求解的问题都分别用不同的图标表示出来了。
- **附录F中的*KCIDE for Circuits***
  新的附录F提供了"知识获取集成设计环境(*KCIDE for Circuits*)"软件的指南。该软件可从ARIS获得。

New to this Edition

A course in circuit analysis is perhaps the first exposure students have to electrical engineering. We have included several new features to help students feel at home with the subject.

- **Four Color Art Program**
  A completely redesigned interior design and four color art program bring circuit drawings to life and enhance key pedagogical elements throughout the text.
- **Extended Examples**
  Examples worked in detail according to the six-step problem-solving method provide a roadmap for students to solve problems in a consistent fashion. At least one example in each chapter is developed in this manner.
- **EC 2000 Chapter Openers**
  Based on ABET's new skill-based CRITERION 3, these chapter openers are devoted to discussions as to how students can acquire the skills that will lead to a significantly enhanced career as an engineer. Because these skills are so very important to the student while in college as well as in their career, we will use the heading, *"Enhancing your Skills and your Career."*
- **Homework Problems**
  Over 300 new end of chapter problems provide students with plenty of practice as well as reinforce key concepts.
- **Homework Problem Icons**
  Icons are used to highlight problems that relate to engineering design as well as problems that can be solved using *PSpice* or *MATLAB*.
- ***KCIDE for Circuits* Appendix F**
  A new Appendix F provides a tutorial on the Knowledge Capturing Integrated Design Environment (*KCIDE for Circuits*) software, available on ARIS.

本书结构

本书可用于2个半年学期或3个1/4年学期线性电路分析的教学。在教师对章节进行适当选择后，本书也可用于1个半年学期的教学。本书可粗略地分为3个部分。

- 第1部分包括1～8章，讨论直流电路，包含了基本定律和定理、分析方法、无源和有源元件。

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, circuits techniques, and passive and active elements.

- Part 2, which contains Chapter 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, Fourier transform, and two-port network analysis.

The material in three parts is more than sufficient for a two-semester course, so the instructor must select which chapters or 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 diverse enough that the instructor can choose some as examples and assign some as homework.

As stated earlier, we are using three icons with this edition. We are using (PSpice icon) to denote problems that either require *PSpice* in the solution process, where the circuit complexity is such that *PSpice* would make the solution process easier, and where *PSpice* makes a good check to see if the problem has been solved correctly. We are using (MATLAB icon) to denote problems where *MATLAB* is required in the solution process, where *MATLAB* makes sense because of the problem makeup and its complexity, and where *MATLAB* makes a good check to see if the problem has been solved correctly. Finally, we use (design icon) to identify problems that help the student develop skills that are needed for engineering design. More difficult problems are marked with an asterisk (*). Comprehensive problems follow the end-of-chapter problems. They are mostly applications problems which require skills learned from that particular chapter.

- 第2部分包括9～14章，讨论交流电路，介绍相量、正弦交流稳态分析、交流功率、有效值、三相系统和频率响应。
- 第3部分包括15～19章，讨论网络分析的高级内容，为学生提供有关拉普拉斯变换、傅里叶级数、傅里叶变换和二端口的完整内容。

这3部分的内容对于2个半年学期来说太多了，因此教师应从中选择章节用于教学。标记"†"号的节可跳过、简单介绍或布置为课后阅读作业。不讲授这些节不会破坏课程的连续性。每章中包含了丰富的题目，按照相关内容的节进行编排。这些题目多种多样，教师可从中选择例题和课后作业。

如前所述，本版中采用了3个图标。PSpice图标用于表示两种题目。第1种情况是问题比较复杂，使用PSpice可简化求解过程；第2种情况是PSpice可用于检验求解的正确性。MATLAB图标也用于表示两种题目。第1种情况是问题比较复杂，使用MATLAB可简化求解过程；第2种情况是MATLAB可用于检验求解的正确性。设计图标表示设计型问题。学生可从中获得工程设计所需的技巧。比较难的题目用"*"表示。每章题目的最后部分都是综合问题。综合问题基本上都是需要将本章内容灵活应用的实际应用中的问题。

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. A very important asset of this text is that ALL the mathematical equations and fundamentals of physics needed by the student, are included in the text.

先修要求

和大多数导论性电路课程类似，使用本书作为教材的课程主要先修要求是大学物理和微积分。虽然熟悉复数有助于本书后面部分的学习，但这并不是必需的。本书很重要的一个特点是包含了所有必需的数学公式和物理基础。

Supplements

McGraw-Hill's ARIS—Assessment, Review, and Instruction System is a complete, online tutorial, electronic homework, and course management system, designed for greater ease of use than any other system available. Free on adoption, instructors can create and share course materials and assignments with other instructors, edit questions and algorithms, import their own content, and create announcements and due dates for assignments. ARIS has automatic grading and reporting of easy-to-assign algorithmically generated homework, quizzing, and testing. Once a student is registered in

补充材料

McGraw-Hill的ARIS系统(评估、复习和指导系统)是一个完整的、支持在线学习、发布电子课后作业和进行课程管理的系统，比其他系统都更容易使用。教师可免费使用，还可以创建并与其他教师共享课程材料和作业、编辑问题和算法、导入自己的内容、发布通知和公布交作业的时间。ARIS可以对用程序生成的家庭作业、测验和考试进行自动打分并给出报告。学生一经注册，他在McGraw-Hill ARIS系

统中的所有活动都会被自动记录。教师可通过完全集成的评分手册获得这些记录。评分手册下载后可用Excel编辑。AIRS还为教师提供了解题手册、书中的图像文件和从其他课程转换到本课程的指导，为学生提供了网络分析指南、软件下载、书中练习的完整解答、FE考试题、记忆卡和网络链接。请访问www.mhhe.com/alexander。

the course, all student activity within McGraw-Hill's ARIS is automatically recorded and available to the instructor through a fully integrated grade book that can be downloaded to Excel. Also included on ARIS are a solutions manual, text image files, and transition guides to instructors, and Network Analysis Tutorials, software downloads, complete solutions to text practice problems, FE Exam questions, flashcards, and web links to students. Visit www.mhhe.com/alexander.

电路知识获取集成设计环境(KCIDE for Circuits)。这个新的软件由NASA资助并由Cleveland州立大学开发，用于帮助学生用书中介绍的六步法求解电路问题。KCIDE for Circuits允许学生用PSpice和MATLAB求解电路问题，跟踪求解过程并保存相应的记录以备将来之用。此外，该软件还自动产生Word文档和/或PowerPoint演示文档。附录F介绍了如何使用KCIDE for Circuits。读者可链接到http://kcide.fennresearch.org/，并从中找到其他例子，ARIS网站上提供了这一链接地址。该软件包可免费下载。

Knowledge Capturing Integrated Design Environment for Circuits (*KCIDE for Circuits*) This new software, developed at Cleveland State University and funded by NASA, is designed to help the student work through a circuits problem in an organized manner using the six-step problem-solving methodology in the text. *KCIDE for Circuits* allows students to work a circuit problem in *PSpice* and *MATLAB*, track the evolution of their solution, and save a record of their process for future reference. In addition, the software automatically generates a Word document and/or a PowerPoint presentation. Appendix F contains a description of how to use the software. Additional examples can be found at the web site, http://kcide.fennresearch.org/, which is linked from ARIS. The software package can be downloaded for free.

解题学习指导。这是一本与本书配套的练习簿。希望练习解题技能的学生可从ARIS获得。这个练习簿讨论了解题策略，包含有完整解答的150道附加题。

Problem Solving Made *Almost* Easy, a companion workbook to *Fundamentals of Electric Circuits*, is available on ARIS for 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.

C.O.S.M.O.S。这是一个仅供教师使用的CD。这是个有力的工具，可帮助教师利用教材的题目和解答以及自己的材料以流程化的方式布置作业题、出测验和考试题。教师可编辑教材章后的题目并记录已布置过的作业题目。

C.O.S.M.O.S This CD, available to instructors only, is a powerful solutions manual tool to help instructors streamline the creation of assignments, quizzes, and tests by using problems and solutions from the textbook, as well as their own custom material. Instructors can edit textbook end of chapter problems as well as track which problems have been assigned.

虽然本教材希望能够自成体系并作为学生学习的辅导，但教学过程中面对面的接触是不应被忽略的。我们希望本书及其附加材料能够为教师提供高水平教学所需的工具。

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 and supplemental materials supply the instructor with all the pedagogical tools necessary to effectively present the material.

致谢

略

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Finally, we appreciate the feedback received from instructors and students who used the previous editions. We want this to continue, so please keep sending us emails or direct them to the publisher. We can be reached at c.alexander@ieee.org for Charles Alexander and sadiku@ieee.org for Matthew Sadiku.

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

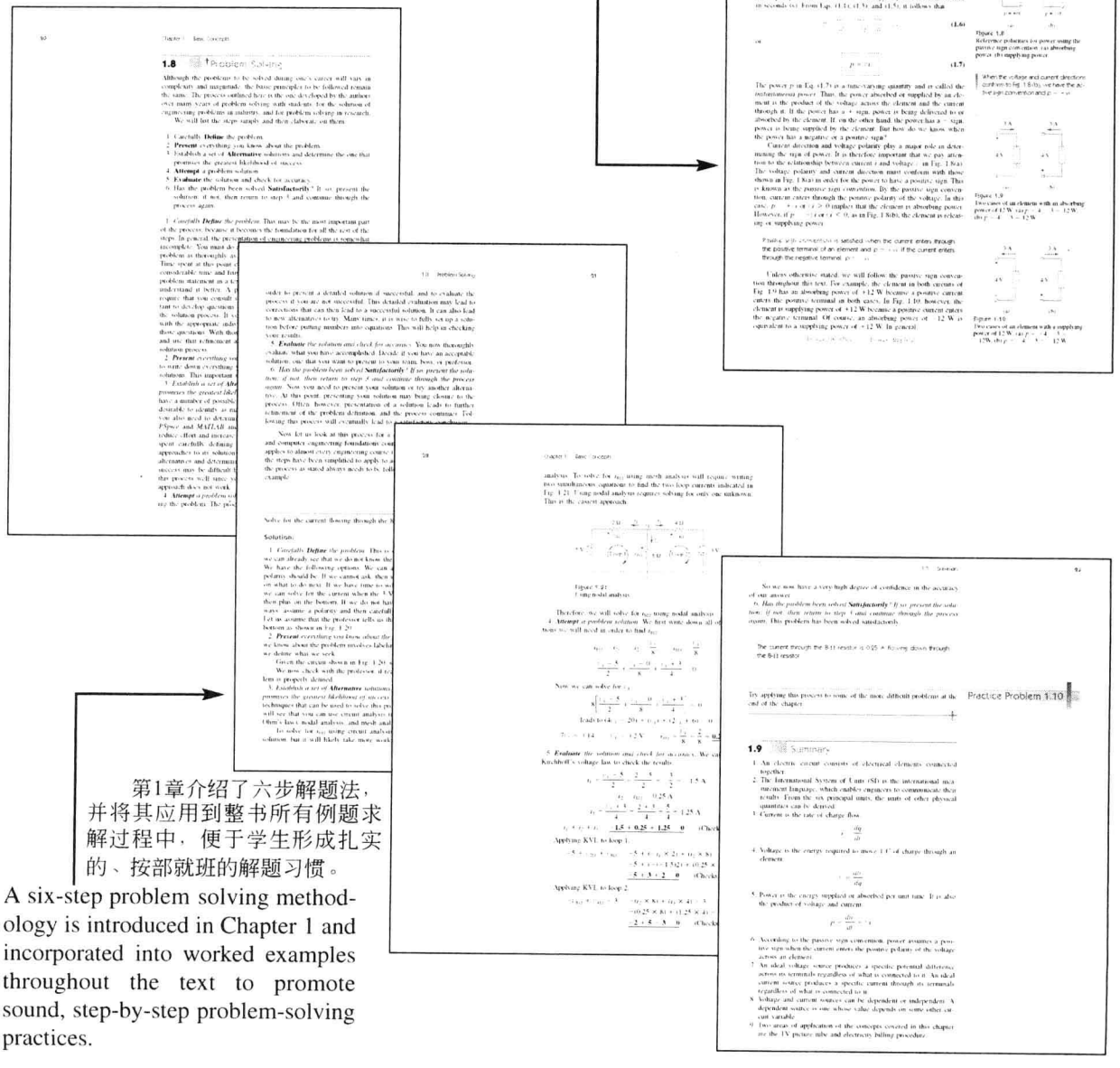
导　读

本书的主要目标是用比其他教材更清晰、更有趣和更容易理解的方式来进行电路分析。对学生而言，了解本书的以下特点有助于学好本课程。

The main objective of this book is to present circuit analysis in a manner that is clearer, more interesting, and easier to understand than other texts. For you, the student, here are some features to help you study and be successful in this course.

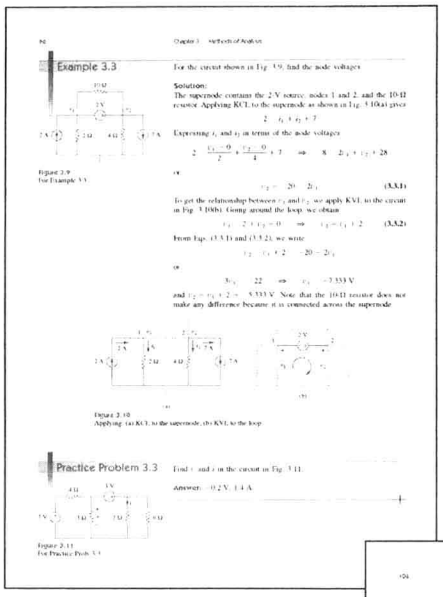
A new four color art program brings circuit drawings to life and enhances key concepts throughout the text.

全文采用新的四种颜色图文排版使电路图生动，并突出重要概念。



第1章介绍了六步解题法，并将其应用到整书所有例题求解过程中，便于学生形成扎实的、按部就班的解题习惯。

A six-step problem solving methodology is introduced in Chapter 1 and incorporated into worked examples throughout the text to promote sound, step-by-step problem-solving practices.


Example 3.3

For the circuit shown in Fig. 3.9, find the node voltages.

Solution:

Figure 2.9
For Example 3.3

Figure 2.10
Applying (a) KCL to the supernode, (b) KVL to the loop.

Practice Problem 3.3

Find v_1 and v_2 in the circuit in Fig. 3.11.

Answer: −0.2 V, 1.4 A.

Figure 2.11
For Practice Prob. 3.3

每个示例性例题后紧跟着给出一个练习题和答案来检验对前面例题的理解。

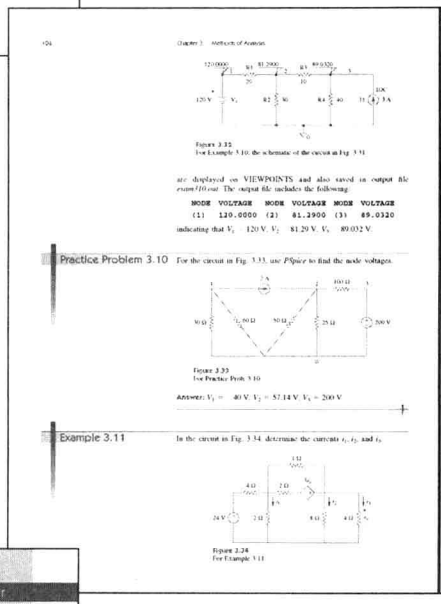
Each illustrative example is immediately followed by a practice problem and answer to test understanding of the preceding example.

PSpice® for Windows is a student-friendly tool introduced to students early in the text and used throughout, with discussions and examples at the end of each appropriate chapter.

Windows环境下的PSpice软件是学生的一个好工具，在书中前面部分便介绍给学生，并贯穿全书。在有关章的靠后部分讨论有关问题，并给出仿真例题。

The last section in each chapter is devoted to applications of the concepts covered in the chapter to help students apply the concepts to real-life situations.

每章的最后一节用来讨论本章所涉及概念的应用，以帮助学生理论联系实际。


Practice Problem 3.10

For the circuit in Fig. 3.33, use *PSpice* to find the node voltages.

Figure 3.33
For Practice Prob. 3.10

Answer: $V_1 = 40$ V, $V_2 = 52.14$ V, $V_3 = 200$ V.

Example 3.11

In the circuit in Fig. 3.34, determine the currents i_1, i_2, and i_3.

Figure 2.34
For Example 3.11

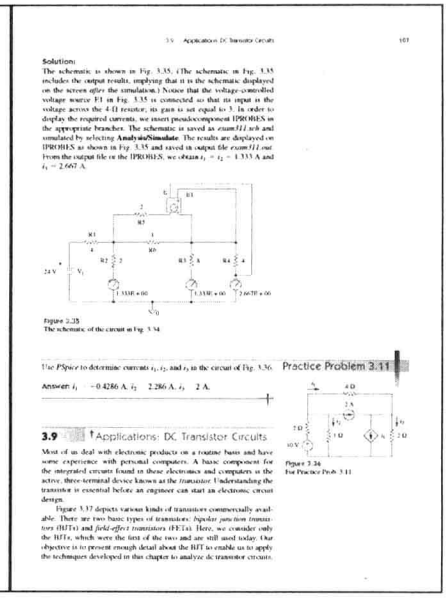


Figure 2.35
The schematic of the circuit in Fig. 3.34.

Use *PSpice* to determine currents i_1, i_2, and i_3 in the circuit of Fig. 3.36.

Answer: $i_1 = -0.4286$ A, $i_2 = 2.286$ A, $i_3 = 2$ A.

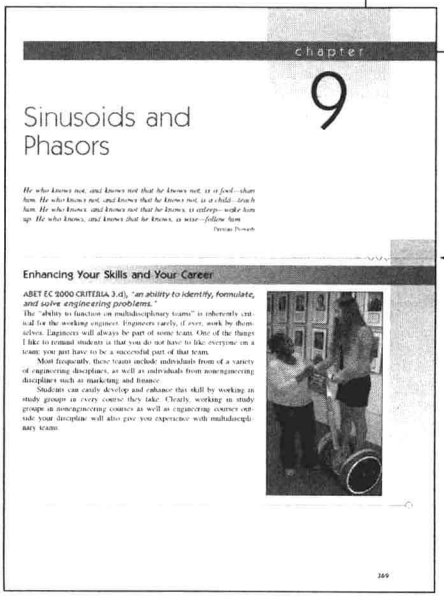
Practice Problem 3.11

Figure 3.36
For Practice Prob. 3.11

3.9 Applications: DC Transistor Circuits

Most of us deal with electronic products on a routine basis and have some experience with personal computers. A basic component for the integrated circuits found in these electronics and computers is the active, three-terminal device known as the *transistor*. Understanding the transistor is essential before an engineer can start an electronic circuit design.

Figure 3.37 depicts various kinds of transistors commercially available. There are two basic types of transistors: *bipolar junction transistors* (BJTs) and *field-effect transistors* (FETs). Here, we consider only the BJTs, which were the first of the two and are still used today. Our objective is to present enough detail about the BJT to enable us to apply the techniques developed in this chapter to analyze dc transistor circuits.


chapter 9

Sinusoids and Phasors

He who knows not, and knows not that he knows not, is a fool—shun him. He who knows not, and knows that he knows not, is a child—teach him. He who knows, and knows not that he knows, is asleep—wake him up. He who knows, and knows that he knows, is wise—follow him.

Persian Proverb

Enhancing Your Skills and Your Career

ABET EC 2000 CRITERIA 3.d), *"an ability to identify, formulate, and solve engineering problems."*

The "ability to function on multidisciplinary teams" is inherently critical for the working engineer. Engineers rarely, if ever, work by themselves. Engineers will always be part of some team. One of the things I like to remind students is that you do not have to like everyone on a team; you just have to be a successful part of that team.

Most frequently, these teams include individuals from of a variety of engineering disciplines, as well as individuals from nonengineering disciplines such as marketing and finance.

Students can easily develop and enhance this skill by working in study groups in every course they take. Clearly, working in study groups in nonengineering courses as well as engineering courses outside your discipline will also give you experience with multidisciplinary teams.

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每章均以讨论开始，有关如何提高解题能力以及如何在职业生涯中取得成功的讨论，也有关于在电气工程领域中某一分支学科有关职业导向的话题，从而使学生清楚他们所学内容的一些实际应用。

Each chapter opens a discussion about how to enhance skills that contribute to successful problem-solving as well as successful careers or a career-oriented talk on a sub-discipline of electrical engineering to give students some real-world applications of what they are learning.

每章后面的作业题中，带图标的题是让学生知道哪些题与工程设计有关，哪些题可用PSpice或MATLAB求解。附录中提供了这些计算机软件的使用说明。

Icons next to the end-of-chapter homework problems let students know which problems relate to engineering design and which problems can be solved using *PSpice* or *MATLAB*. Appendices on these computer programs provide tutorials for their use.

对学生和教师的补充说明

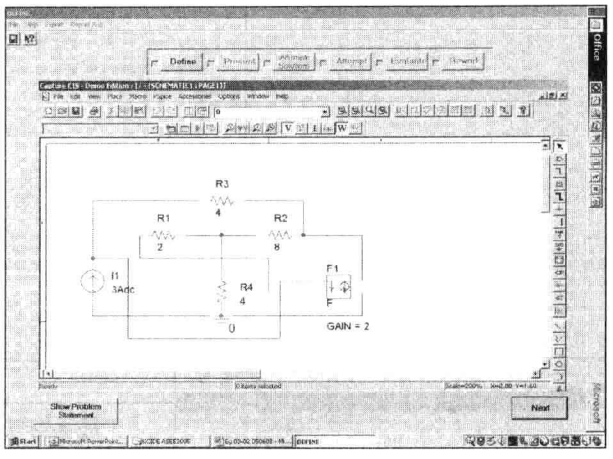
McGraw-Hill ARIS，即评估(Assessment)、复习(Review)和指导(Instruction)系统是全在线教程，电子课后作业和课程管理系统。比起现有的其他系统，它使用起来更简单。该系统可免费使用，教师们可创建并与其他教师共享课程资料与课外作业，编辑问题和算法，导入自己的材料，发布通知和公布交作业时间。ARIS可对程序生成的课后作业、测验和考试进行自动打分并给出报告。注册本课程后，学生在McGraw-Hill ARIS中所有行为均自动记录在案，教师可通过可下载完整的评分手册获取这些学生信息，并用Excel编辑。

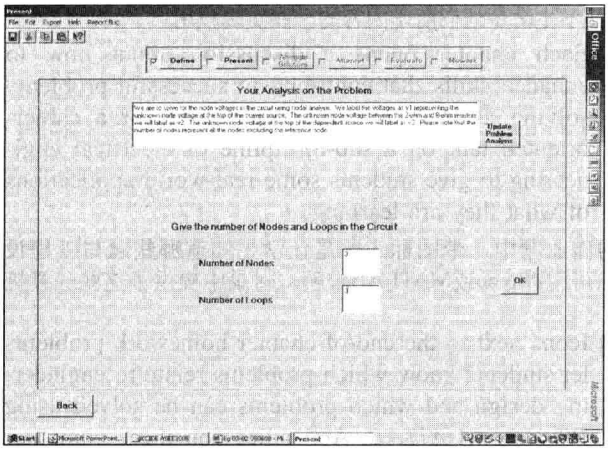
Supplements for Students and Instructors

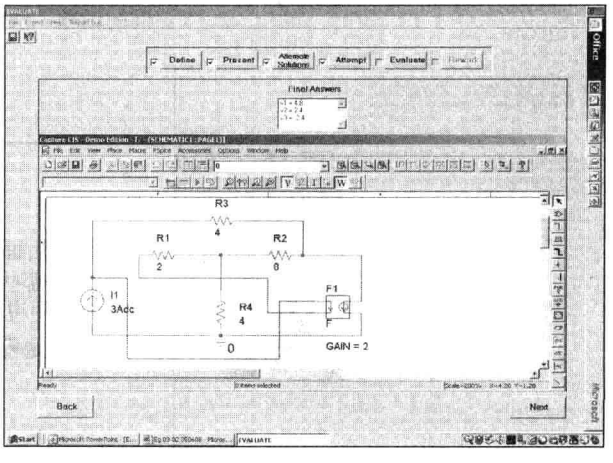
ARIS™ McGraw-Hill's ARIS—Assessment, Review, and Instruction System is a complete online tutorial, electronic homework, and course management system, designed for greater ease of use than any other system available. Free on adoption, instructors can create and share course materials and assignments with other instructors, edit questions and algorithms, import their own content, and create announcements and due dates for assignments. ARIS has automatic grading and reporting of easy-to-assign algorithmically generated homework, quizzing, and testing. Once a student is registered in the course, all student activity within McGraw-Hill's ARIS is automatically recorded and available to the instructor through a fully integrated grade book that can be downloaded to Excel.

电路知识获取集成设计环境(KCIDE for Circuits，ARIS网站上在到该软件主页的链接)软件可加强学生对本书六步解题法的理解。该软件允许学生用PSpice和MATLAB解电路题，跟踪和保存解题过程以便供将来参考。有一个新附录来帮助读者熟悉这一解题过程。

Knowledge Capturing Integrated Design Environment for Circuits (*KCIDE for Circuits*) software, linked from ARIS, enhances student understanding of the six-step problem solving methodology in the book. *KCIDE for Circuits* allows students to work a circuit problem in *PSpice* and *MATLAB*, track the evolution of their solution, and save a record of their process for future reference. A new text appendix walks the user through this program.







Other resources provided on ARIS.

For Students:

— Network Analysis Tutorials—a series of interactive quizzes to help students practice fundamental concepts in circuits.

— FE Exam Interactive Review Quizzes—chapter based self-quizzes provide hints for solutions and correct solution methods, and help students prepare for the NCEES Fundamentals of Engineering Examination.

— Problem Solving Made *Almost* Easy—a companion workbook to the text featuring 150 additional problems with complete solutions.

— Complete Solutions to Practice Problems in the Text
— Flashcards of Key Terms
— Web Links

For Instructors:

— Image Sets—electronic files of text figures for easy integration into your course presentations, exams, and assignments.
— Transition Guides—compare coverage of the third edition to other popular circuits books at the section level to aid transition to teaching from our text.

ARIS提供的其他资源

为学生提供：

— 网络分析教程(Network Analysis Tutorials)——一系列交互式的测验帮助学生熟悉电路的基本概念。
— FE考试复习交互式测验(FE Exam Interactive Review Quizzes)——基于每一章的自测练习，提供答案和正确的解题方法，帮助学生准备NCEES工程基础考试。
— 解题学习指导(Problem Solving Made Almost Easy)——一本与课本配套的有完整解答的150道附加题练习簿。
— 书中练习题的完整解答。
— 关键术语Flash卡片。
— 网站链接。

为教师提供：

— 图集——课文插图的电子文档，可方

— 过渡指南——逐节比较本书第三版与其他流行电路书的差别，便于教师从其他教材过渡到本教材。

C.O.S.M.O.S. CD-ROM

本CD仅供教师使用。这是个有力的工具，可帮助教师利用教材的题目和解答以及自己的材料以流程化的方式布置作业题、出测验和考试题。教师可编辑教材章后的题目并记录已布置的作业。

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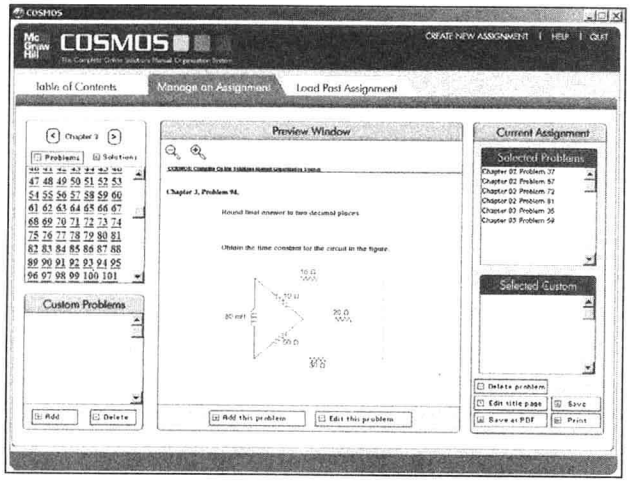

A Note to the Student
给学生的一点提示

This may be your first course in electrical engineering. Although electrical engineering is an exciting and challenging discipline, the course may intimidate you. This book was written to prevent that. A good textbook and a good professor are an advantage—but you are the one who does the learning. If you keep the following ideas in mind, you will do very well in this course.

- This course is the foundation on which most other courses in the electrical engineering curriculum rest. For this reason, put in as much effort as you can. Study the course regularly.
- Problem solving is an essential part of the learning process. Solve as many problems as you can. Begin by solving the practice problem following each example, and then proceed to the end-of-chapter problems. The best way to learn is to solve a lot of problems. An asterisk in front of a problem indicates a challenging problem.
- *Spice*, a computer circuit analysis program, is used throughout the textbook. *Pspice*, the personal computer version of *Spice*, is the popular standard circuit analysis program at most universities, *Pspice for Windows* is described in Appendix D. Make an effort to learn *Pspice*, because you can check any circuit problem with *Pspice* and be sure you are handing in a correct problem solution.
- *MATLAB* is another software that is very useful in circuit analysis and other courses you will be taking. A brief tutorial on *MATLAB* is given in Appendix E to get you started. The best way to learn *MATLAB* is to start working with it once you know a few commands.
- Each chapter ends with a section on how the material covered in the chapter can be applied to real-life situations. The concepts in this section may be new and advanced to you. No doubt, you will learn more of the details in other courses. We are mainly interested in gaining a general familiarity with these ideas.
- Attempt the review questions at the end of each chapter. They will help you discover some "tricks" not revealed in class or in the textbook.
- Clearly a lot of effort has gone into making the technical details in this book easy to understand. It also contains all the mathematics and physics necessary to understand the theory and will be very useful in your other engineering courses. However, we have also focused on creating a reference for you to use both in school as well as when working in industry or seeking a graduate degree.
- It is very tempting to sell your book after you have completed your classroom experience; however, our advice to you is *DO NOT SELL YOUR ENGINEERING BOOKS!* Books have always been expensive, however, the cost of this book is virtually the same as I paid for my circuits text back in the early 60s in terms of real dollars. In fact, it is actually cheaper. In addition, engineering books of the past are no where near as complete as what is available now.

本课程也许是你学习的第一门电气工程类课程。尽管电气工程是令人兴奋和富有挑战性的学科，但课程也许会使你感到困难。为此，我们编写了本书。一本好教材和一名好教授是一种优势——但学习还要靠自己。将如下的意见牢记于心将有助于你学好本课程。

- 本课程是电气工程类其他课程的基础。基于此，要尽最大努力来学习。记住学习要有规律。
- 做题是学习过程的基本组成部分。应尽可能多做题。首先做每个例子后面的练习题，然后再做每章后的习题。最好的学习方法就是大量地做习题。题前有星号的表示是难题。
- 计算机电路分析程序Spice的应用贯穿全书。Spice的个人计算机版PSpice是在许多大学流行的标准电路分析程序。在附录D中介绍了PSpice for Windows。要努力学会使用PSpice，因为可用其检查任何电路问题，并保证提交正确的电路解答。
- MATLAB是电路分析和其他课程中将用到的另一个非常有用的软件。附录E是MATLAB的简单入门介绍。学会使用MATLAB的最好途径是，只要知道了几个简单的命令，便可以开始利用它工作。
- 每章结尾都有一节关于本章所包含的内容如何应用于实际的介绍。这一节的概念对你可能是新的和超前的。毫无疑问，你将在其他课程学到更多与此有关的详细内容。我们的目的是使大家对这些概念有一般性的了解。
- 要尝试做每章后面的复习习题。这将帮你发现课堂上和书本里没有讨论的内容。
- 容易看出，作者投入大量精力使得技术细节容易理解。本书同时还包含了所有数学和物理方面的必须知识，这些知识对理解电路理论是必要的，并且在其他工程类课程中也是很有用的。同时，本书也着眼于成为在校学习、将来工作、或将来攻读研究生学位时的参考书。
- 完成课堂的学习后卖掉课本是非常有诱惑力的。但我们建议你不要卖掉工程类书籍。书籍总是昂贵的。然而你买这本书所花的美元数目，实际上与早在20世纪60年代我买电路课本时花掉的数目是一样的。事实上，现在的还便宜些。此外，过去的工程书籍不像现在的书籍这样完备。当我还是学生的时候，