普通高等教育"十一五"国家级规划教材

21世纪高等学校电子信息工程规划教材

# 信息科学与电子工程专业英语

王朔中 黄素娟 编著

清华大学出版社

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## 内 容 简 介

本书选材兼顾经典题材和新兴技术，在编写中力求改革创新，摈弃从语法到语法、死记硬背的陈旧教学方法，强调大量实践，注重培养学生以较高准确性和足够的速度阅读专业资料和文献的能力，兼顾一定的专业英语表达能力。

全书共 20 单元，各单元包括课文、词汇、难点注释、课外阅读资料、习题。课文内容涉及电子技术、通信工程、信息处理、计算机应用等领域的基础知识和新技术进展，每一单元包括 2～3 篇科技文章或技术资料，注意较广的科技英语基本词汇和不同的语言难度。对部分科技术语和重要概念提供简要的英文辅助资料，以便于理解课文，并在学习科技英语的同时扩大专业知识面。书后附有关于科技英语阅读、写作、克服中式英语等问题的指南和讨论。

本教材可供高等院校信息科学、通信工程、电子技术、计算机应用等专业的本科生和研究生学习专业英语之用，亦可供广大英语学习爱好者参考。



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# 出版说明

随着我国高等教育规模的扩大和产业结构调整的进一步完善，社会对高层次应用型人才的需求将更加迫切。各地高校紧密结合地方经济建设发展需要，科学运用市场调节机制，合理调整和配置教育资源，在改革和改造传统学科专业的基础上，加强工程型和应用型学科专业建设，积极设置主要面向地方支柱产业、高新技术产业、服务业的工程型和应用型学科专业，积极为地方经济建设输送各类应用型人才。各高校加大了使用信息科学等现代科学技术提升、改造传统学科专业的力度，从而实现传统学科专业向工程型和应用型学科专业的发展与转变。在发挥传统学科专业师资力量强、办学经验丰富、教学资源充裕等优势的同时，不断更新其教学内容、改革课程体系，使工程型和应用型学科专业教育与经济建设相适应。

为了配合高校工程型和应用型学科专业的建设和发展，急需出版一批内容新、体系新、方法新、手段新的高水平电子信息类专业课程教材。目前，工程型和应用型学科专业电子信息类专业课程教材的建设工作仍滞后于教学改革的实践，如现有的电子信息类专业教材中有不少内容陈旧（依然用传统专业电子信息教材代替工程型和应用型学科专业教材），重理论、轻实践，不能满足新的教学计划、课程设置的需要；一些课程的教材可供选择的品种太少；一些基础课的教材虽然品种较多，但低水平重复严重；有些教材内容庞杂，书越编越厚；专业课教材、教学辅助教材及教学参考书短缺，等等，都不利于学生能力的提高和素质的培养。为此，在教育部相关教学指导委员会专家的指导和建议下，清华大学出版社组织出版本系列教材，以满足工程型和应用型电子信息类专业课程教学的需要。本系列教材在规划过程中体现了如下一些基本原则和特点：

（1）系列教材主要是电子信息学科基础课程教材，面向工程技术应用培养。本系列教材在内容上坚持基本理论适度，反映基本理论和原理的综合应用，强调工程实践和应用环节。电子信息学科历经了一个多世纪的发展，已经形成了一个完整、科学的理论体系，这些理论是这一领域技术发展的强大源泉，基于理论的技术创新、开发与应用显得更为重要。

（2）系列教材体现了电子信息学科使用新的分析方法和手段解决工程实际问题。利用计算机强大功能和仿真设计软件，使得电子信息领域中大量复杂的理论计算、变换分析等变得快速简单。教材充分体现了利用计算机解决理论分析与解算实际工程电路的途径与方法。

（3）系列教材体现了新技术、新器件的开发应用实践。电子信息产业中仪器、设备、产品都已使用高集成化的模块，且不仅仅由硬件来实现，而是大量使用软件和硬件相结合方法，使得产品性价比很高，如何使学生掌握这些先进的技术、创造性地开发应用新技术是本系列教材的一个重要特点。

（4）以学生知识、能力、素质协调发展为宗旨，系列教材编写内容充分注意了学生创新能力和实践能力的培养，加强了实验实践环节，各门课程均配有独立的实验课程和课程设计。

（5）21世纪是信息时代，学生获取知识可以是多种媒体形式和多种渠道的，而不再局限于课堂上，因而传授知识不再以教师为中心，以教材为唯一依托，而应该多为学生提供各类学习资料（如网络教材，CAI课件，学习指导书等）。应创造一种新的学习环境（如讨论，自学，设计制作竞赛等），让学生成为学习主体。该系列教材以计算机、网络和实验室为载体，配有多种辅助学习资料，提高学生学习兴趣。

繁荣教材出版事业，提高教材质量的关键是教师。建立一支高水平的以老带新的教材编写队伍才能保证教材的编写质量和建设力度，希望有志于教材建设的教师能够加入到我们的编写队伍中来。

**21世纪高等学校电子信息工程规划教材编委会**

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# Preface

This textbook of technical English is intended for teaching undergraduates and graduate students majoring in information technology, communication engineering, electronic engineering, computer and related subjects.

English as a medium of communication is very important in students' future career. Our graduates will face a diversity of scientific articles, technical documents, product manuals, commercials, and other materials in English. However, having learned English ever since they entered primary school, many university students in their junior and senior years still lack adequate experiences and abilities in using the language as a tool. They are unable to acquire information and knowledge in the fast growing technological fields, let alone express themselves in English orally or in written form. The problem does not primarily lie in grammar or vocabulary. Indeed, many students have a good mastery of the *knowledge about English*, but perhaps not the English language itself. They may know almost every rule of the grammar as well as a fairly large quantity of words, even rarely used ones. Some show extraordinary skills in tackling various exams. When coming to practical uses, however, things become quite different. Many students find it difficult to read technical materials at a reasonable speed and catch the message accurately, and don't know how to write in English correctly.

In view of the above, we emphasize actual use of the language, rather than the grammar. Taking into account the limited classroom hours and the practical needs of most students, this course mainly focuses on teaching student to read. The book covers a range of topics including communications, signal and information processing, electronic circuits and systems, microwaves, optical fibers, biomedical engineering, computer science, etc. Each unit consists of a text of 2500-3500 words in two or three parts, a vocabulary, some notes on the text, materials for off-classroom reading, and exercises. The exercises are not designed for grammar review, but rather, should be used as a supplement in improving students' reading ability.

It should be noted that, without a substantial amount of reading practice outside the classroom and continuous efforts after this course, only attending the lectures is far from enough for a student to be able to use technical English proficiently. Therefore, students are strongly encouraged to read as much as possible, not confined to the materials in the textbook.

Writing is not the main objective of the course. Nonetheless, we believe that reading proficiency resulting from intensive practical use and a good habit of careful observation while reading will greatly help enhance writing ability. Notes on how to write technical English are included in the Appendix.

This textbook is a result of many years' teaching practice of the authors and all members of the teaching group. The authors wish to express their sincere thanks to Chen Quanlin, Shi Hai, Zhu Qiuyu, Shi Xuli and Li Yingjie for their contributions and invaluable help over the years.

Without doubt, this book needs further improvements. Therefore any comments or recommendations are sincerely welcome and highly appreciated.

Wang Shuozhong, Huang Sujuan

October, 2007

# 前　言

本教材是为信息科学、通信工程、电子技术、计算机应用等专业的本科生、研究生学习科技英语而编写的。本书选材力求覆盖较广泛的专业方向，注重兼顾经典题材和新兴技术，对部分基本原理或新概念提供相关英文辅助资料，以便教师结合课文有选择地用英语讲述一些专业基础知识，或者供学生阅读，使他们在学习科技英语的同时扩大专业知识面。

英语是理工科学生必须掌握的实用工具，但不少学生在学了十多年英语以后，仍不能有效地运用英语获取专业知识和科技信息，更不用说用英语进行科技交流了。根据这种情况，并结合大学英语教学现状，我们在本书的编写过程中力求改革创新，拒绝应试教学，摈弃从语法到语法、死记硬背的陈旧教学方法，强调大量实践，主张阅读准确性和阅读速度并重，兼顾英语表达能力的提高。

我们认为，大学高年级和研究生专业英语教学应以培养和提高英语运用能力为根本目的。这些学生并不缺少语法知识，而是缺少实践。他们很少甚至没有读过科技英语资料，没有掌握丰富的表达形式，缺乏正确的语感。我国学生语法基础普遍较好，但在阅读中往往过分依赖语法分析。他们不了解语法的作用应是内在的和深层的，而不是表面的。依赖语法分析不仅阅读速度上不去，而且即使看懂了句子，读完全文可能还是抓不住要点。这种现象相当普遍。实际上理工科学生学外语并不是为了研究语言，而是要运用语言，因此应以感性认识和反复实践为主，语法知识学习为辅。基于这一认识，我们在课文注释中尽量避免使用语法术语，以期学生在阅读实践中提高阅读能力，最终甩掉语法拐棍。只有这样才能逐步做到顺序阅读而不用回头看，达到理解准确性和阅读速度的统一。

写作不是本教材的重点，但阅读能力的突破以及在阅读中的留心观察，对于写作能力的形成和提高具有关键性的作用。附录中收入了我们在科技英语阅读和写作方面的体会，其中包括一些探索性的研究心得和观点。此外本书还讨论了普遍存在的中式英语问题，根据大量实例分析了一些典型情况，并就如何克服中式英语提出了我们的看法，供读者参考并希望得到专家的指教。

本书是对2004年版《信息与通信工程专业科技英语》的全面改编，扩大了适用范围，充实了电子科学与技术、计算机技术和应用等方面的内容；加强了反映信息和电子学科新技术的课文；提供了不同难度的课文，适当增加了阅读材料以适应更广泛的要求，便于学生扩大阅读量。

本教材反映了教学小组全体教师多年来在教学中积累的经验，编者特别要感谢陈泉林、石海、朱秋煜、石旭利、李颖洁老师所提供的帮助和支持。

因编者水平所限，书中差错和不当之处在所难免，敬请读者不吝指正。

王朔中，黄素娟

2008年2月

# Contents

# Unit 1 Electronics: Analog and Digital

Signals in electronics may be of two types, analog or digital. Digital instruments are in general more precise than analog ones and they easily transmit information even over very long distances. However most electronic designs include a combination of both real-world analog signals and digital signals.

## Text

### Part I: Ideal Operational Amplifiers and Practical Limitations

In order to discuss the ideal parameters of operational amplifiers, we must first define the terms, and then go on to describe what we regard as the ideal values for those terms. At first sight, the specification sheet for an operational amplifier seems to list a large number of values, some in strange units, some interrelated, and often confusing to those unfamiliar with the subject. The approach to such a situation is to be methodical, and take the necessary time to read and understand each definition in the order that it is listed. Without a real appreciation of what each means, the designer is doomed to failure. The objective is to be able to design a circuit from the basis of the published data, and know that it will function as predicted when the prototype is constructed.[1] It is all too easy with linear circuits, which appear relatively simple when compared with today's complex logic arrangements, to ignore detailed performance parameters which can drastically reduce the expected performance.[2]

Let us take a very simple but striking example. Consider a requirement for an amplifier having a voltage gain of 10 at 50 kHz driving into a 10 kΩ load.[3] A common low-cost, internally frequency-compensated op amp is chosen; it has the required bandwidth at a closed-loop gain of 10, and it would seem to meet the bill.[4] The device is connected, and it is found to have the correct gain. But it will only produce a few volts output swing when the data clearly shows that the output should be capable of driving to within two or three volts of the supply rails.[5] The designer has forgotten that the maximum output voltage swing is severely limited by frequency, and that the maximum low-frequency output swing becomes limited at about 10 kHz. Of course, the information is in fact on the data sheet, but its relevance has not been appreciated. This sort of problem occurs regularly for the inexperienced designer. So the moral is clear: always take the necessary time to write down the full operating requirements before attempting a design. Attention to the detail of the performance specification will always be beneficial. It is suggested the following list of performance details be considered:

1. Closed loop gain accuracy, stability with temperature, time and supply voltage
2. Power supply requirements, source and load impedances, power dissipation
3. Input error voltages and bias currents. Input and output resistance, drift with time and temperature
4. Frequency response, phase shift, output swing, transient response, slew rate, frequency stability, capacitive load driving, overload recovery
5. Linearity, distortion and noise
6. Input, output or supply protection required. Input voltage range, common-mode rejection
7. External offset trimming requirement

Not all of these terms will be relevant, but it is useful to remember that it is better to consider them initially rather than to be forced into retrospective modifications.

**All parameters are subject to wide variations**

Never forget this fact. How many times has a circuit been designed using typical values, only to find that the circuit does not work because the device used is not typical?[6] The above statement thus poses a tricky question: when should typical values and when should worst-case values be used in the design? This is where the judgment of the experienced designer must be brought to bear. Clearly, if certain performance requirements are mandatory, then worst-case values must be used. In many cases, however, the desirability of a certain defined performance will be a compromise between ease of implementation, degree of importance, and economic considerations.[7]

**Do not over-specify or over-design**

In the end, we are all controlled by cost, and it is really pointless taking a sledgehammer to crack a nut, Simplicity is of the essence since the low parts count implementation is invariably cheaper and more reliable.[8]

As an example of this judgment about worst-case design, consider a low-gain DC transducer amplifier required to amplify 10 mV from a voltage source to produce an output of 1 V with an accuracy of ±1% over a temperature range of 0~70°C.[9] Notice that the specification calls for an accuracy of ±1%. This implies that the output should be 1 V ±10 mV from 0 ~ 70°C. The first step is, of course, to consider our list above, and decide which of the many parameters are relevant. Two of the most important to this (very limited) specification are offset voltage drift and gain stability with temperature. We will assume that all initial errors are negligible (rarely the case in practice). The experienced designer would know that most op amps have a very large open-loop gain, usually very much greater than 10000. A closed-loop gain change of ±1% implies that the loop gain (as explained later) should change by less than ±100% for a closed-loop gain of 100.[10] This is clearly so easily fulfilled that the designer knows immediately that he can use typical open-loop gain values in his calculations. However, offset voltage drift is another matter. Many op amp specifications include only typical values for offset voltage drift; this may well be in the order of 5 μV/°C, with an unquoted maximum for any device of 30 μV/°C.[11] If by chance we use a device which has this worst-case drift, then the amplifier error could be 30×70=2100 μV=2.1 mV over temperature, which is a significant proportion of our total allowable error from all sources.

Here is a case, then, where one can be confident that the typical value of open-loop gain can be used, but where the maximum value of drift may well cause significant errors. This sort of judgment is essential in careful design, and great care is required in interpreting manufacturers' data. This consideration must be extended to all the details listed above apart from the fact that worst-case values are often not quoted. It is often found that values given are not 100% tested. Statistical testing is employed which, for example, guarantees that 90% of all devices fall within the range specified. It could be very inconvenient for the user who relies on the specified performance and then finds that he has several of the 'other' 10% actually plugged into his circuit.[12]

## Part II: Data Registers and Counters

### Data register

The simplest type of register is a data register, which is used for the temporary storage of a "word" of data. In its simplest form, it consists of a set of *N* D flip-flops, all sharing a common clock. All of the digits in the *N* bit data word are connected to the data register by an *N*-line "data bus". Figure 1.1 shows a 4 bit data register, implemented with four D flip-flops. The data register is said to be a synchronous device, because all the flip-flops change state at the same time.

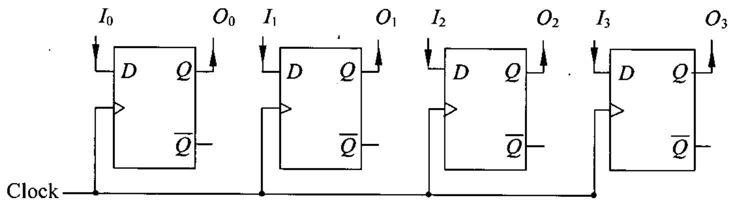


*Figure 1.1 Four-bit D register*

### Shift registers

Another common form of register used in computers and in many other types of logic circuits is a shift register. It is simply a set of flip-flops (usually D latches or RS flip-flops) connected together so that the output of one becomes the input of the next, and so on in series.[1] It is called a shift register because the data is shifted through the register by one bit position on each clock pulse.[2] Figure 1.2 shows a 4 bit shift register, implemented with D flip-flops.