刘传菊 王员根 唐 宇◎编著

信息工程专业英语教程

An English Course for Information Engineering

中山大学出版社

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专业英语教程

Course for Engineering

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内 容 简 介

本书的主要目的是使读者了解和掌握电子信息工程、通信工程和自动化专业英语术语及其用法，培养和提高他们用英语表达和解决专业问题的能力，使其能够阅读和翻译专业英语文献。全书分为4个部分，每部分由5篇课文组成，主要内容包括信息工程基础、电子信息、通信和自动化，涵盖了信息工程领域的主要技术分支。

本书可作为电子信息工程、通信工程和自动化专业英语教程，也可供从事相关专业工作的工程技术人员参考使用。

前　言

信息工程是当今国内外发展最为迅速、技术革新最为活跃的工程领域之一。为了应对这种国际化的竞争，当今大学生在本科学习阶段就应打下坚实的基础，而专业英语的阅读和写作能力就是信息工程专业毕业生所应具备的一项最基本的能力。

本书以培养和提高学生信息工程专业英语阅读和写作能力，扩展、深化大学生对本学科关键前沿技术的认识，培养具备国际竞争力的技术人才为目的；在充分吸收当前最新技术成果和外语教学成果的基础上，为信息工程专业学生提供一个提高专业英语水平的平台。

为了保证本书内容的前沿性和实用性，本书所有的文章均选自国内外最近几年信息工程领域的教材、专著及国际著名新闻网站提供的工程应用技术报道，并适当增加了课题组在信息隐藏领域以及农业信息化领域的最新研究成果。在具体内容的遴选上，编者尽量保证学生利用已学过的专业知识理解英文教材内容，并使学生通过学习，加深对本专业知识的理解，从而提高专业英语的表达能力和写作能力。

编者结合信息工程专业英语多年的教学实践及农林高等院校信息类专业英语课程特色，对本书进行了全面的构思和统筹。全书分为4个部分，每部分由5篇课文组成，涵盖了信息工程领域的主要技术分支。信息工程基础部分由电路基础、模拟电子技术、数字电子技术、信号与系统和微机原理5篇课文组成；电子信息部分由A/D和D/A转换器、放大器电路、嵌入式系统、集成电路和光电技术5篇课文组成；通信部分由数字信号处理、移动通信技术、信息压缩处理、图像处理技术和数字隐写与取证技术5篇课文组成；自动化部分由传感器、农业工程、自动化、工业机器人和人工智能5篇课文组成。因此，本书既可以作为信息工程专业的本科教学用书，也可以作为信息工程工

作者的自学用书。

本书第一部分由刘传菊、王员根、唐宇老师共同撰写，第二部分由唐宇老师撰写，第三部分由王员根老师撰写，第四部分由王员根、唐宇老师共同撰写。王员根老师负责课后习题及参考答案的编写工作，刘传菊教授负责全书的统稿工作。本书在编写过程中得到了广州仲恺农业工程学院教务处和信息学院的大力支持，在此一并表示感谢。

由于编者水平有限，编写时间仓促，书中错误和问题难免，恳切希望各位专家、读者予以指正。

编　者

2011 年 3 月

Contents

Chapter 1 Information Engineering

Chapter 2 Electronics Information

Chapter 3 Communication

Chapter 4 Automation

Chapter 1

Information Engineering

Lesson 1 Electronics Device

One of the key inventions in the history of electronics, and in fact one of the most important inventions over period, was the ***transistor***. It was invented by Bell Laboratories in 1948. In short, a transistor is a ***device*** that conducts a variable amount of electricity through it, depending on how much electricity is input to it. However, unlike the ***vacuum tube***, it is solid state. This means that it doesn't change its physical form as it switches. Also, there are no moving parts in a transistor.

The advantages of the transistor over the vacuum tube are enormous. Compared with the old vacuum technology, transistors are much smaller, faster, and cheaper to ***manufacture***. They are also far more reliable and use much less power. It is the transistor that started the evolution of the modern computer industry in motion.

By careful chemical composition and arrangement, it is possible to create a very small transistor directly on a layer of ***silicon***. A special material is used to make these transistors. While most materials either insulate from electrical flow (air, glass, wood) or ***conduct*** electricity readily (metals, water), there are some that only conduct electricity a small amount, or only under certain conditions. These are called semiconductors. The most commonly used semiconductor is of course silicon. What allowed the creation of modern processors was the invention of the ***integrated circuit***, which was a group of transistors manufactured from a single piece of material and connected together internally, without extra wiring. Integrated circuits are also called ICs for short or chips.

The first IC was invented in 1959 by Jack Kilby of Texas Instruments (TI) and Robert Noyce of Fairchild Semiconductor Corporation. Robert Noyce is a computer industry pioneer and Intel cofounder. He is also credited as the co-inventor of the integrated circuit a. k. a. microchip along with Jack Kilby. It contained just six transistors on a single semiconductor surface and wasn't popular till the middle 1960s when the Fairchild released the uA709. This was the first commercially successful IC ***op amp***. The major drawback of the uA709 was stability; it required external compensation and a competent ***analog*** engineer to apply it. Also, the uA709 was quite sensitive because it had a habit of self-destruction under any adverse condition. The uA741 follows the uA709, and it is an internally compensated op amp that does not require external compensation if operated under data sheet conditions. There has been a never-ending series of new op amps released each year since then, and their performance and reliability have improved to the point where at present they can be used for analog applications by anybody.

After the invention of the integrated circuit, it took very little time to realize the tremendous benefits of ***miniaturizing*** and integrating larger numbers of transistors into the same integrated circuit. More transistors, namely digital switches, were required in order to implement more complicated functions. ***Miniaturization*** was the key to integrating together large numbers of transistors while increasing hardware speed and keeping power consumption and space requirements.

As time progressed after the invention of LSI, the technology improved and chips became smaller, faster and cheaper. Building on the success of earlier integration efforts, engineers learned to pack more and more logic into a single circuit. Originally, the functions performed by a processor were implemented using several different logic chips. Intel was the first company to incorporate all of these logic components into a single chip. This was the first ***microprocessor***, the 4004, introduced by Intel in 1971. All of today's processors (whereas highly advanced) are descendants of this original 4-bit CPU.

Words and Expressions

transistor [træn'zɪstə] 晶体管
device [dɪ'vaɪs] 器件，装置
vacuum tube 真空管
manufacture [ˌmænju'fæktʃə] 制造，制造业
silicon ['sɪlɪkən] 硅
conduct ['kəndʌkt] 传导，引导；导电传导性
integrated ['ɪntɪgreɪtɪd] 整合的，综合的
integrated circuit 集成电路
op amp (operational amplifier 的缩写形式) 放大器，运算放大器
analog ['ænələg] 模拟的；相似物，类似事情
miniaturize ['mɪnətʃəraɪz] 使微型化，使小型化
miniaturization [mɪnətʃəraɪ'zeɪʃn] 小型化
microprocessors [ˌmaɪkrəu'prɔsesəz] 微处理器

Lesson 2 Circuit Analysis Using the Ideal Operational Amplifier

Ideal Operational Amplifier

In order to introduce operational amplifier circuitry, we will use an ideal model of the operational amplifier to simplify the mathematics involved in deriving ***gain*** expressions, etc., for the circuits presented. With this understanding as a basis, it will be convenient to describe the properties of the real devices themselves in later sections, and finally to investigate circuits utilizing practical operational amplifiers. To begin the presentation of operational amplifier circuitry, then, it is necessary first of all to define the properties of a ***mythical*** "perfect" operational amplifier. The model of an ideal operational amplifier is shown in Fig. 2. 1.

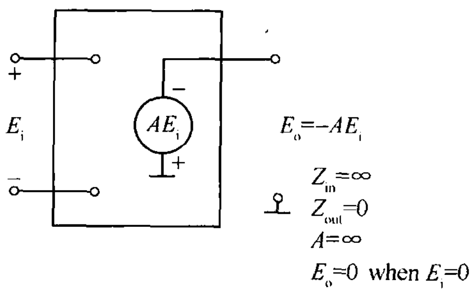


Fig. 2. 1 Equivalent circuit of the ideal operational amplifier

Defining the Ideal Operational Amplifier:

● Gain: The primary function of an amplifier is to amplify, so the more gain the better. It can always be reduced with external circuitry, so we assume gain to be infinite.

● Input ***Impedance***: Input impedance is assumed to be infinite. This is why the driving source won't be affected by power being drawn by the ideal operational amplifier.

● Output Impedance: The output impedance of the ideal operational amplifier is assumed to be zero. It then can supply as much current as necessary to the load being driven.

● Response Time: The output must occur at the same time as the ***inverting input***, so the response time is assumed to be zero. ***Phase shift*** will be 180°. Frequency response will be flat and ***bandwidth*** will be infinite because AC will be simply a rapidly varying DC level to the ideal amplifier.

- ***Offset***: The amplifier output will be zero when a zero signal appears between the inverting and non-inverting inputs.

- A ***Summing Point Restraint***: An important ***by-product*** of these properties of the ideal operational amplifier is that the summing point, the inverting input, will conduct no current to the amplifier. This property is to become an important tool for circuit analysis and design, for it gives us an ***inherent*** restraint on our circuit—a place to begin analysis. Later on, it will also be shown that both the inverting and non-inverting inputs must remain at the same voltage, giving us a second powerful tool for analysis as we progress into the circuits of the next section.

A description of the ideal operational amplifier model was presented in the last section, and the introduction of complete circuits may now begin. Though the ideal model may seem a bit remote from reality—with infinite gain, bandwidth, etc., it should be realized that the ***closed loop gain*** relations which will be derived in this section are directly applicable to real circuits—to within a few tenths of a percent in most cases. We will show it later with a convincing example.

The Desirability of Feedback

Consider the open loop amplifier used in the circuit of Fig. 2.2. Note that no current flows from the source into the inverting input—the summing point restraint derived in the previous section—hence, there is no voltage drop across R_s and E_s appears across the amplifier input. When E_s is zero, the output is zero. If E_s takes on any non-zero value, the output voltage increases to ***saturation***, and the amplifier acts as a switch.

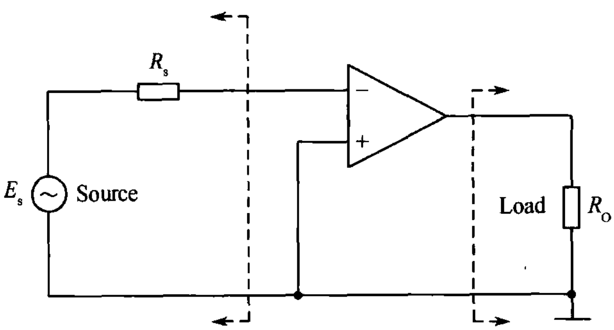
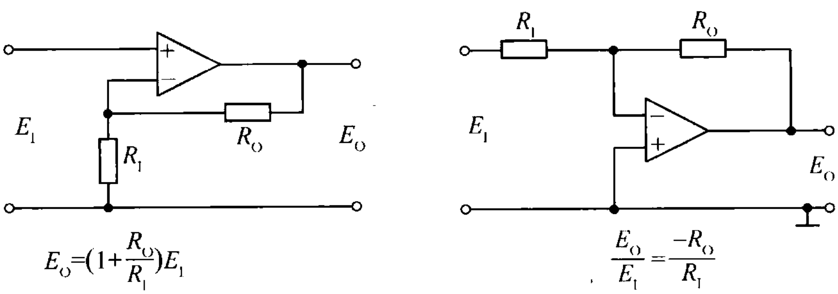


Fig. 2.2 Open loop operation

The open loop amplifier is not practical—once an op amp is pushed to saturation, its behavior is unpredictable. Recovery time from saturation is not specified for op amps (except voltage limiting types). It may not recover at all; the output may ***latch*** up. The output structure of some op amps, particularly rail-to-rail models, may draw a lot of current as the output stage attempts to drive to one or the other rail.

Two Important Feedback Circuits

Fig. 2.3 shows the connections and the gain equations for two basic feedback circuits. The application of negative feedback around the ideal operational amplifier results in another important summing point restraint: The voltage appearing between the inverting and non-inverting inputs approaches zero when the feedback loop is closed.



(a) Non-inverting (b) Inverting

Fig. 2.3 Basic amplifier circuits

Consider either of the two circuits shown in Fig. 2.3. If a small voltage, measured at the inverting input with respect to the non-inverting input, is assumed to exist, the amplifier output voltage will be of opposite ***polarity*** and can always increase in value (with infinite output available) until the voltage between the inputs becomes ***infinitesimally*** small. When the amplifier output is fed back to the inverting input, the output voltage will always take on the value required to drive the signal between the inputs toward zero.

The two summing point restraints are so important that they are repeated:

- No current flows into either input terminal of the ideal operational amplifier.
- When negative feedback is applied around the ***ideal operational amplifier***, the differential input voltage approaches zero.

These two statements will be used repeatedly in the analysis of the feedback circuits to be presented in the rest of this section.

Words and Expressions

gain [geɪn] 增益
mythical [ˈmɪθɪkəl] 神话的，虚构的
impedance [ɪmˈpiːdəns] 阻抗
inverting input 反相输入端
phase shift 相移
bandwidth [ˈbændwɪdθ] 频带宽度，通带宽度
offset [ˈɔfset] 偏移量；抵消；平版印刷；支派；弯管
summing point 求和点
restraint [rɪˈstreɪnt] 约束（条件）
by-product 副产品；出乎意料的结果
inherent [ɪnˈhɪərənt] 固有的，内在的；与生俱来的
closed loop gain 闭环增益
open loop gain 开环增益
saturation [sætʃəˈreɪʃn] 饱和（状态），饱和度
latch [lætʃ] 锁存器
polarity [pəˈlærəti] 极性
infinitesimally [ˌɪnfɪnɪˈtesɪməli] 无穷小地，极小地
ideal operation amplifier 理想运算放大器（abbr. ideal op amp）
differential input amplifier 差分放大器
voltage follower 电压输出（跟随）器

Lesson 3 Digital Electronics

Digital electronics represent signals by discrete bands of analog levels, rather than by a continuous range. All levels within a band represent the same signal state. Relatively small changes to the analog signal levels due to manufacturing tolerance, signal attenuation or ***parasitic*** noise do not leave the discrete envelope, and as results are ignored by signal state sensing circuitry.

In most cases the number of these states is two, and they are represented by two voltage bands: one near zero volts and a higher level near the supply voltage, corresponding to the "false" ("0") and "true" ("1") values of the ***Boolean*** domain respectively.

Digital techniques are useful because it is easier to get an electronic device to switch into one of a number of known states than to accurately ***reproduce*** a continuous range of values.

Digital electronics are usually made from large assemblies of logic gates, simple electronic ***representations*** of Boolean logic functions.

One advantage of digital circuits when compared to analog circuits is that signals represented digitally can be ***transmitted*** without ***degradation*** due to noise. For example, a continuous audio signal, transmitted as a ***sequence*** of 1s and 0s, can be ***reconstructed*** without error provided the noise picked up in transmission which is not enough to prevent identification of the 1s and 0s. An hour of music can be stored on a compact ***disc*** as about 6 billion binary digits.

In a digital system, a more precise representation of a signal can be obtained by using more binary digits to represent it. While this requires more digital circuits to process the signals, each digit is handled by the same kind of hardware. In an analog system, additional resolution requires fundamental improvements in the linearity and noise characteristics of each step of the signal chain.

Computer-controlled digital systems can be controlled by software, allowing new functions to be added without changing hardware. Often this can be done outside of the factory by updating the product's software. So, the product's design errors can be corrected when the product is in a customer's hands.

Information storage can be easier in digital systems than in analog ones. The noise-immunity of digital systems permits data to be stored and retrieved without degradation. In an analog system, noise from aging and wearing degrade the information stored. In a digital system, as long as the total noise is below a certain level, the information can be recovered perfectly.

In some cases, digital circuits use more energy than analog circuits to accomplish the same tasks, thus producing more heat. In portable or battery-powered systems this can limit the use of digital systems.

For example, battery-powered cellular telephones often use a low-power analog front-end to amplify and tune in the radio signals from the base station. However, a base station has grid power and can use power-hungry, but very flexible software radios. Such base stations can be easily reprogrammed to process the signals used in new cellular standards.

Digital circuits are sometimes more expensive, especially in small quantities.

The sensed world is analog, and signals from this world are analog quantities. For example, light, temperature, sound, electrical conductivity, electric and magnetic fields are analog. Most useful digital systems must translate from continuous analog signals to discrete digital signals. This causes quantization errors.

Quantization errors can be reduced if the system stores enough digital data to represent the signal to the desired degree of fidelity. The ***Nyquist-Shannon*** sampling ***theorem*** provides an important guideline as to how much digital data is needed to accurately portray a given analog signal.

In some systems, if a single piece of digital data is lost or misinterpreted, the meaning of large blocks of related data can completely change. Because of the cliff effect, it can be difficult for users to tell if a particular system is right on the edge of failure, or if it can tolerate much more noise before failing.

Digital fragility can be reduced by designing a digital system for robustness. For example, a ***parity*** bit or other error management method can be inserted into the signal path. These schemes help the system detect errors, and then either correct the errors, or at least ask for a new copy of the data. In a ***state-machine***, the state transition logic can be designed to catch unused states and trigger a reset sequence or other error recovery routine.

Digital memory and transmission systems can use techniques such as error detection and correction to use additional data to correct any errors in transmission and storage.

On the other hand, some techniques used in digital systems make those systems