Specialized English for Electrical Engineering and Automation

电气工程及自动化专业英语

◎ 李月琴　编著

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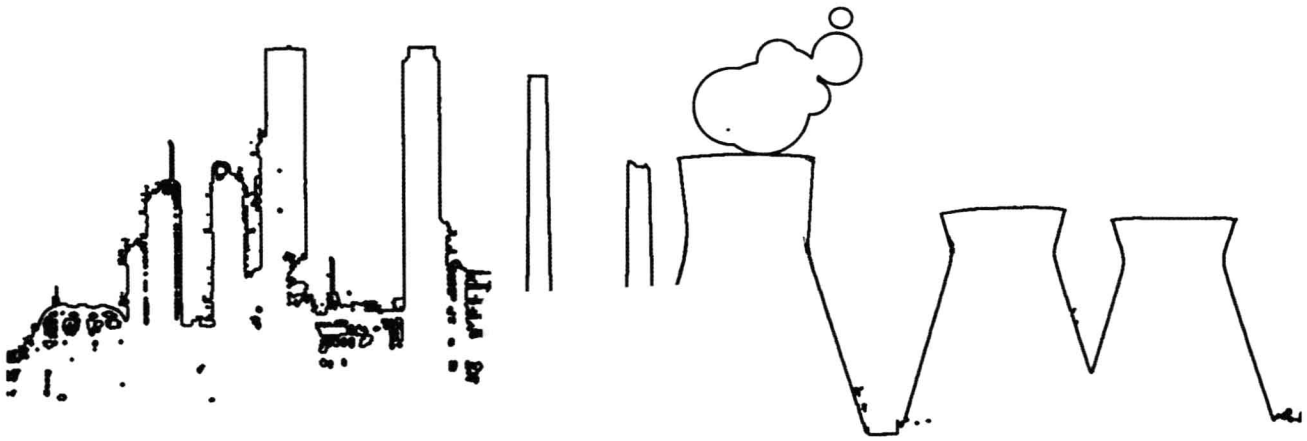

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内 容 提 要

电气工程及自动化领域是当今国内外发展迅速、技术更新活跃的工程领域之一。为了扩展并深化学生对本学科关键技术的认识，促进具有国际竞争力人才的培养，本书内容不仅包括电气工程和自动化的基础知识，还精选了有关数字信号处理、图像处理、互联网等新兴领域的文章。每个单元的课文内容新颖、难度适中，生词均配有音标，语言难点解释深入浅出。此外，翻译技巧部分则结合例句言简意赅地讲解了科技英语阅读和翻译的特点及基本方法。

本书每个单元都附有练习题，利用与单元主题相关的材料，以选择、填空、英汉互译等形式培养学生掌握专业英语的能力。书后还附有课文的参考译文及练习题的参考答案。

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前　言

随着科技进步和社会发展，我国对专业人才的英语能力要求越来越高。电气工程及自动化领域是当今国内外发展迅速、技术更新活跃的工程领域之一。为了应对国际化竞争，更好地培养学生的专业英语能力，有效提高学生英语阅读和写作水平，扩展并深化学生对本学科关键技术的认识，促进具有国际竞争力的人才培养，编者本着通俗易懂、先进实用的选材原则和简明系统的组织原则编写了这本《电气工程及自动化专业英语》。

为了保证本书的先进性和实用性，本书的绝大部分文章均摘自国外近几年电气工程及自动化各个领域的教材及专著（详见参考文献），具体内容尽量保证学生能利用既有专业知识理解课文，并能使学生通过学习加深和扩展相关的专业知识。

全书共分为六个单元，即电气工程和电子学、能源和电力系统、电机和变压器、现代控制系统、计算机控制系统和其他技术。内容涵盖了电子技术基础、电力工程技术、电机与变压器、现代控制理论、计算机控制技术、电路仿真、传感器技术、数字信号处理、图像处理、互联网等领域。课文内容丰富、题材广泛，能满足学生对专业英语的学习需求。每个单元包含四课，每课内容包括课文、生词、专业术语、课文注释和翻译技巧。其中，课文侧重展示本主题领域的核心或关键技术，生词包含了课文中出现的国家英语四级词汇之外的其他词汇，课文注释旨在解决课文中英语语言的难点，翻译技巧总结了科技英语阅读和翻译的特点和基本方法等。每个单元后面都附有练习题，练习题利用与单元主题相关的材料，以选择、填空、英汉互译的形式培养学生掌握专业英语的阅读和写作能力。在本书书后还附有课文的参考译文及练习题的参考答案。

本书可作为电气工程、自动化及相关专业的专业英语及科技英语教材，每课参考学时 2 学时。

本书的编写工作得到了北京联合大学信息学院的大力支持。王建防高级工程师和韩磊博士为本书的编写工作提出了宝贵意见，在此一并表示衷心的感谢。

由于时间仓促，编者水平有限，书中难免有纰漏和不足之处，恳请广大读者批评指正。

编　者

2012 年 5 月于北京联合大学

目　录

Unit 1 Electrical Engineering and Electronics

Lesson 1 Overview of Electrical Engineering

Electrical engineers design systems that have two main objectives:

- To gather, store, process, transport, and present information.
- To distribute, store, and convert energy between various forms.

In many electrical systems, the manipulation of energy and the manipulation of information are interdependent. For example, numerous aspects of electrical engineering relating to information are applied in weather prediction. Data about cloud cover, precipitation, wind speed, and so on are gathered electronically by weather satellites, by land-based radar station, and by sensors at numerous weather stations. This information is transported by electronic communication systems and processed by computers to yield forecasts that are disseminated and displayed electronically[1].

In electrical power plants, energy is converted from various sources to electrical form. Electrical distribution systems transport the energy to virtually every factory, home, and business in the world, where it is converted to a multitude of useful forms, such as mechanical energy, heat, and light[2].

No doubt you can list scores of electrical engineering applications in your daily life. Increasingly, electrical and electronic features are integrated into new products. Automobiles and trucks provide just one example of this trend. The electronic content of the average automobile is growing rapidly in value. Auto designers realize that electronic technology is a good way to provide increased functionality at lower cost.

As another example, we note that many common household appliances contain keypads for operator control, sensors, electronic displays, and computer chips, as well as more conventional switches, heating elements, and motors. Electronics have become so intimately integrated with mechanical systems that a new name, mechatronics, is beginning to be used for the combination[3].

Electrical Engineering Application Areas

Next, we discuss the eight major areas of electrical engineering briefly.

(1) **Communication systems** transport information in electrical form. Cellular phone, radio, satellite television, and the Internet are examples of communication systems. It is possible for virtually any two people (or computers) on the globe to communicate almost instantaneously. A

climber on a mountaintop in Nepal can call or send e-mail to friends whether they are hiking in Alaska or sitting in a New York City office. This kind of connectivity affects the way we live, the way we conduct business, and the design of everything we use.

（2）**Computer systems** process and store information in digital form. No doubt you have already encountered computer applications in your own field. Beside the computers of which you are aware, there are many in unobvious places, such as household appliances and automobiles[4]. A typical modern automobile contains several dozen special-purpose computers.

（3）**Control systems** gather information with sensors and use electrical energy to control a physical process. A relatively simple control system is the heating/cooling system in a residence. A sensor (thermostat) compares the temperature with the desired value. Control circuits operate the furnace of air conditioner to achieve the desired temperature.

（4）**Electromagnetics** is the study and application of electric and magnetic fields. The device (known as a magnetron) used to produce microwave energy in an oven is one application. Cellular phone and television antennas are also examples of electromagnetic devices.

（5）**Electronics** is the study and application of materials, devices, and circuits used in amplifying and switching electrical signals. The most important electronic devices are transistors of various kinds. They are used in nearly all places where electrical information or energy is employed.

（6）**Photonics** includes light generation by lasers and light-emitting diodes, transmission of light through optical components, as well as switching, modulation, amplification, detection, and steering light by electrical, acoustical, and photon-based devices. Current applications include readers for DVD disks, holograms, optical signal processors, and fiber-optic communication systems. Future applications include optical computers, holographic memories, and medical devices.

（7）**Power systems** convert energy to electrical form and transmit energy over long distances. These systems are composed of generators, transformers, distribution lines, motors, and other elements.

（8）**Signal processing** is concerned with information-bearing electrical signals. Often, the objective is to extract useful information from electrical signals derived from sensors.

New Words

electronically [ˌilekˈtrɔnikli] *adv.* 电子地；用电子装置，用电子方法
objective [əbˈdʒektiv] *n.* 目标，目的；（显微镜的）（接）物镜；[语法]宾格 *adj.* 客观的；[语法]宾格的
gather [ˈgæðə] *n.* 集合，聚集 *vi.* 集合，聚集 *vt.* 使聚集，搜集，积聚，推断
manipulation [məˌnipjuˈleiʃən] *n.* 处理，操作，操纵，被操纵
interdependent [ˌintə(ː)diˈpendənt] *adj.* 相互依赖的，互助的
prediction [priˈdikʃən] *n.* 预言，预报

precipitation [pri,sipi'teiʃən] *n.* 仓促，降水量
land-based ['lændbeist] *adj.* 以地面为基地的
sensor ['sensə] *n.* 传感器
disseminate [di'semineit] *v.* 散布
integrate ['intigreit] *vt.* 使成整体，使一体化；求……的积分 *v.* 结合
functionality [,fʌŋkəʃə'næliti] 功能性，泛函性
keypad ['ki:pæd] *n.* 键区
chip [tʃip] *n.* 碎片；筹码 *v.* 削成碎片，碎裂；芯片
intimately ['intimətli] *adv.* 密切地
briefly ['bri:fli] *adv.* 暂时地，简要地
cellular ['seljulə] *adj.* 细胞的
instantaneous [,instən'teinjəs] *adj.* 瞬间的，即刻的，即时的
climber ['klaimə] *n.* 登山者；攀缘植物
Nepal [nə'pɔ:l] *n.* 尼泊尔（亚洲国家）
hiking ['haikiŋ] *n.* 徒步旅行
Alaska [ə'læskə] *n.* 阿拉斯加州（美国州名）
connectivity [,kənek'tiviti] *n.* 连通性
unobvious [ʌn'ɔbviəs] *adj.* 不明显的,不显著的
thermostat ['θə:məstæt] *n.* 自动调温器，温度调节装置
conditioner [kən'diʃənə] *n.* 调节者，调节装置
electromagnetics [i,lektrəumæg'netiks] *n.* [物]电磁学
magnetron ['mægnitrɔn] *n.* 磁电管
microwave ['maikrəuweiv] *n.* 微波（波长为 1 毫米至 30 厘米的高频电磁波）
antenna [æn'tenə] *n.* 天线
transistor [træn'zistə] *n.* 晶体管
photonics [fəu'tɔniks] [*pl.*] *n.* 光子学
diode ['daiəud] *n.* 二极管
modulation [,mɔdju'leiʃən] *n.* 调制
amplification [,æmplifi'keiʃən] *n.* 扩大，扩充；增幅，放大（率）；放大倍数膨胀
steering ['stiəriŋ] *n.* 操纵，掌舵，指导
acoustical [ə'ku:stik(ə)l] *adj.* 听觉的，声学的
holograph ['hɔləugrɑ:f] *n.* 亲笔文件；[律] 亲笔信；[物] 全息图
fiber ['faibə] *n.* =fibre 光纤
bearing ['beəriŋ] *n.* 轴承；关系；方面；意义；方向，方位

Phrases & Expressions

mechatronics 机电一体化
cellular phone 便携式电话

light-emitting diode (LED) 发光二极管

Notes

[1] This information is transported by electronic communication systems and processed by computers to yield forecasts that are disseminated and displayed electronically.

译文：这些信息经过电子通信系统的传输和计算机的处理后，通过电的形式进行传播和显示，从而进行天气预报。

说明：that 在本句中作为关系代词引导限定性定语从句，在从句中作主语，代替的先行词是 forecasts。限定性定语从句是先行词不可缺少的部分，去掉它主句意思往往不明确。如：

This is the house which we bought last month. 这是我们上个月买的那栋房子。

另外，关系代词在定语从句中作主语时，从句谓语动词的人称和数要和先行词保持一致。如：

Is he the man that wants to see you? 他就是想见你的人吗？（that 在从句中作主语）

[2] Electrical distribution systems transport the energy to virtually every factory, home, and business in the world, where it is converted to a multitude of useful forms, such as mechanical energy, heat, and light.

译文：电力分配系统将能量传输到世界各个工厂、家庭和企业，在那里，能量被转化成各种有用的形式，如机械能、热能和光能。

说明：where 作为关系副词在本句中引导非限定性定语从句，是对“factory，home，and business”的附加说明。非限定性定语从句是先行词的附加说明，去掉了也不会影响主句的意思，它与主句之间通常用逗号分开。如：

The house, which we bought last month, is very nice. 这栋房子很漂亮，是我们上个月买的。

注意：关系代词 that 和关系副词 why 不能引导非限制性定语从句。

[3] Electronics have become so intimately integrated with mechanical systems that a new name, mechatronics, is beginning to be used for the combination.

译文：电子学已经和机械系统紧密地结合在一起，这种结合使一个新名词应运而生，即“机电一体化”。

说明： 本句是 so...that...句型引导的结果状语从句，用来修饰 intimately，意思是“如此/这么……以至于……”。

[4] Beside the computers of which you are aware, there are many in unobvious places, such as household appliances and automobiles[3].

译文：但除此之外，计算机还被应用到许多不为人们注意的地方，比如家用电器和汽车。

说明：句中 of which 是“介词+which”结构，用来引导定语从句修饰 the computers；句中 such as 用来引出 unobvious places 的同位语。

Translating Skills

科技英语翻译的标准、过程和方法

科技英语翻译是一种典型的内容重于风格的翻译，译者的任务是根据原作者的思想，用另一种语言精确传达原文的信息。这就要求译者必须熟悉了解所译的内容，在确切理解的基础上，很好地应用译文语言把原文的内涵通顺流畅地展现给读者。

1. 翻译的标准

科技英语文章翻译的好坏可以用“忠实、流畅、专业术语正确”这三方面标准来衡量。

忠实：指忠于原文内容，译文应当准确无误地传达原文的真实含义，使作者能确切了解原文的内容和精神，并能如实领会原文的风格和文采。

流畅：指译文应当通顺流畅地表达原文的意思，语言通俗易懂，符合语言规范。

专业术语正确：指进行科技英语翻译时，一定要使用相关专业的专业术语，不能直译或使用非专业语言。例如：

the fluid of electricity 应译作“电流”，而不能译作“电的流动”；

the electric resistance 应译作“电阻”，而不能译作“电的反抗”。

另外，“忠实、流畅、专业术语正确”这三方面标准是相辅相成、缺一不可的，译者既不能任意删改，也不能逐词死译，更不能离开原文随意发挥，不然就会造成读者看不懂、与原作者的风格和内容相脱离等情况。例如：

（1）Force is any push or pull that tends to produce or prevent motion.

正译：力是能产生或阻止运动的任何形式的推或拉。

误译：力是任何倾向于产生或阻止运动的推或拉。

（2）The moment the circuit is completed, a current will start flowing toward the coil.

正译：电路一旦接通，电流就开始流向线圈。

误译：电路被完成这一刻，一个电流将开始流向这个线圈。

2. 翻译的过程

翻译过程一般需要经过理解、表达、校对三个阶段。

理解阶段：在理解原文时，首先应把全篇文章通读一遍，领会文章大意，然后明辨语法，弄清关系，最后结合上下文，逐句推敲。

表达阶段：即选择恰当的汉语语言，把已经理解了的原作的内容叙述出来。

校对阶段：该阶段是对上两个阶段的内容进行校对，检查译文是否能准确无误地表述原作内容，译文的语言表达是否规范，是否符合汉语逻辑和习惯。

3. 翻译的方法

翻译一般来说有直译和意译两种方法。

直译基本上保留原文的语法结构形式，在语序或句序上未作大的变动。保留原文词语的字面意义，未加以引申和转换。凡是原文结构接近汉语，表达符合汉语语法修辞习惯的都可以而且应该直译。

大部分情况下，翻译时会对语序稍作变动，如：

（1）The only forces between molecules are secondary bond forced of attraction. 分子间唯一的力是次价键的引力。

（2）One property associated with the glassy state is a low volume coefficient of expansion 玻璃态的特征之一是体积膨胀系数较低。

意译就是在忠于原文内容的基础上，不拘泥于原文形式进行翻译。如：

（3）If you know the frequency, you can find the wave length. 如果知道频率，就能求出波长。

（英语中代词使用的较多，而汉语中却较少使用代词，翻译过程中可将无用的代词省略，这里省略了代词 you。）

Lesson 2 Electric Circuit Parameters and Components

An electric circuit consists of various types of circuit elements connected in closed paths by conductors[1]. The purpose of electric circuits is to distribute and convert energy into some other forms. Accordingly, the basic circuit components are energy source, energy converter and conductors connecting them.

Electrical Current

Electrical current is the time rate of flow of electrical charge through a conductor or circuit element. The units are amperes (A), which are equivalent to coulombs per second (C/s). The charge on an electron is -1.602×10^{-19}C. If we obtain a record of the net charge as a function of time denoted as $q(t)$, the electrical current flowing through the element in the reference direction is given by

$$i(t)=\frac{\mathrm{d}q(t)}{\mathrm{d}t}$$

A constant current of one ampere means that one coulomb of charge passes through the cross section of circuit element each second. Current flow is the same for all cross sections of a circuit element. The current that enters one end flows through the element and exits through the other end[2].

Voltage

When charge moves through circuit elements, energy can be transferred. The voltage associated with a circuit element is the energy transferred per unit of charge that flows through the element[3]. The units of voltage are volts (V), which are equivalent to joules per coulomb (J/C).

Voltages are assigned polarities that indicate the direction of energy flow. If positive charge moves from the positive polarity through the element toward the negative polarity, the element absorbs energy that appears as heat, mechanical energy, stored chemical energy, or as some other form. On the other hand, if positive charge moves from the negative polarity toward the positive polarity, the element supplies energy. Voltages can be constant with time or they can vary. Constant voltages are called DC voltages. On the other hand, voltages that change in magnitude

and alternate in polarity with time are said to be AC voltages.

Power

The basic unit of power is the watt (W), named after James Watt (1736-1819), who also invented the steam engine. Because the circuit element's current i is the rate of flow of charge and the voltage v is a measure of the energy transferred per unit of charge, the product of the current and voltage is the rate of energy transfer. In other words, the product of current and voltage is power:

$$p=vi$$

A positive value for p indicates that energy is absorbed by the element, and a negative value shows that energy is supplied by the element. If the circuit element happens to be an electrochemical battery, positive power means that the battery is being charged. In other words, the energy absorbed by the battery is being stored as chemical energy. On the other hand, negative power indicates that the battery is being discharged. Then the energy supplied by the battery is delivered to some other element in the circuit.

Conductors

Charge flows easily through conductors, which are represented by lines connecting circuit elements. Conductors correspond to connecting wires in physical circuits. Ideal conductors are represented in circuit diagrams by unbroken lines between the ends of other circuit elements. The voltage between the ends of an ideal conductor is zero regardless of the current flowing through the conductor. When two points in a circuit are connected together by an ideal conductor, we say that the points are shorted together. If no conductors or other circuit elements are connected between two parts of a circuit, we say that an open circuit exists between the two parts of the circuit[4]. No current can flow through an ideal open circuit.

Sources

An energy source (a primary or secondary cell, a generator, and the like) converts chemical, mechanical, thermal or some other form of energy into electric energy. Voltage sources and current sources are two types of ideal sources in electrical circuits. An ideal independent voltage source maintains a specified voltage across its terminals. The voltage across the source is independent of other elements that are connected to it and of the current flowing through it. An ideal independent current source forces a specified current to flow through itself. The current is independent of the elements connected to it and of the voltage across it.

Resistors

The resistor is an electrical device whose primary function is to introduce resistance to the flow of electric current. The magnitude of opposition to the flow of current is called the resistance of the resistor. A larger resistance value indicates a greater opposition to current flow. The resistance is measured in ohms. An ohm is the resistance that arises when a current of one ampere is passed

through a resistor subjected to one volt across its terminals. In other words, for a resistor, resistance R, the potential difference v across it when there is a current i through it is given by:

$$v=Ri$$

The various uses of resistors include setting biases, controlling gain, fixing time constants, matching and loading circuits, voltage division, and heat generation.

Capacitors

Capacitors are constructed by separating two sheets of conductor, which is usually metallic, by a thin layer of insulating material. The insulating material between the plates, called a dielectric, can be air, paper, glass, mylar, mica, or other nonconductive materials.

Suppose that current flows downward, as electrons move upward, they collect on the lower plate of the capacitor. Thus, the lower plate accumulates a net negative charge that produces an electric field in the dielectric. This electric field forces electrons to leave the upper plate at the same rate that they accumulate on the lower plate. Therefore, current appears to flow through the capacitor. As the charge builds up, voltage appears across the capacitor. We say that the charge accumulated on the plate is stored in the capacitor. In an ideal capacitor, the stored charge q is proportional to the voltage between the plates:

$$q=Cv$$

The constant of proportionality is capacitance C, which has units of farads (F). Farads are equivalent to coulombs per volt.

Inductors

An inductor is constructed by coiling a wire around some type of form. Current flowing through the coil creates a magnetic field or flux that links the coil. When the current changes in value, the resulting magnetic flux changes. According to Faraday's law of electromagnetic induction, time-varying magnetic flux linking a coil induces voltage across the coil. For an ideal inductor, the voltage is proportional to the time rate of change of the current[5]. Furthermore, the polarity of the voltage is such as to oppose the change in current. The constant of proportionality is called inductance, usually denoted by the letter L. In equation form, the voltage and current are related by

$$v(t)=L\frac{\mathrm{d}i}{\mathrm{d}t}$$

Inductance has units of henries (H), which are equivalent to volt seconds per ampere.

New Words

parameter [pə'ræmitə] *n.* 参数，参量；<口>起限定作用的因素
ampere ['æmˌpiə] *n.* [电]安培
conductor [kən'dʌktə] *n.* 领导者，经理；导体；避雷针
converter [kən'və:tə(r)] *n.* 炼钢炉，（吹风）转炉；换流器，变换器，变流器
coulomb ['ku:lɔm] *n.* [电]库仑（电量单位）

joule [dʒu:l] *n.* 焦耳
polarity [pəu'læriti] *n.* 极性
magnitude ['mægnitju:d] *n.* 大小，数量；巨大，广大；量级
alternate [ɔ:l'tə:nit] *adj.* 交替的，轮流的；预备的 *v.* 交替，轮流；改变
electrochemical [i,lektrəu'kemikəl] *adj.* 电气化学的
unbroken ['ʌn'brəukən] *adj.* 未破损的，完整的；继续的
thermal ['θə:məl] *adj.* 热的，热量的
resistor [ri'zistə] *n.* 电阻器
opposition [ɔpə'ziʃən] *n.* 反对；敌对；相反；反对派
ohm [əum] *n.* 欧姆
bias ['baiəs] *n.* 偏见，偏爱；偏差；偏压
matching ['mætʃiŋ] *n.* 匹配
loading ['ləudiŋ] *n.* 装载，装填
fixing ['fiksiŋ] *n.* 固定，稳固；设备；安装，修理；调料
capacitor [kə'pæsitə] *n.*（=capacitator）电容器
metallic [mi'tælik] *adj.* 金属（性）的
insulating ['insjuleitiŋ] *adj.* 绝缘的
dielectric [,daii'lektrik] *n.* 电介质，绝缘体 *adj.* 非传导性的
mylar ['maila:(r)] *n.* 聚酯薄膜
mica ['maikə] *n.* 云母
nonconductive ['nɔnkən'dʌktiv] *adj.* 不传导的，绝缘的
proportionality [prə,pɔ:ʃə'næliti] *n.* 比例（性），均衡（性），相称
capacitance [kə'pæsitəns] *n.* 容量，电容
inductor [in'dʌktə] *n.* 感应器
flux [flʌks] *n.* 流量，通量
inductance [in'dʌktəns] *n.* 感应系数，自感应

Phrases & Expressions

electrical current　电流
be equivalent to 相当于……，与……等效
net charge　净电荷
reference direction 参考方向
constant current 恒定电流
positive charge 正电荷，阳电荷
negative polarity 负极性
DC or dc = Direct Current 直流电
AC or ac= Alternating Current　交流电
watt[wɔt] *n.* 瓦特（1736—1819，英国工程师，发明家）