普通高等教育“十一五”国家级规划教材
PUTONG GAODENG JIAOYU SHIYIWU GUOJIAJI GUIHUA JIAOCAI

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电气工程及其自动化专业英语

苏小林　顾雪平　主编

中国电力出版社
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Electrical Engineering

内 容 提 要

本书为普通高等教育“十一五”国家级规划教材。

全书共分九章，主要内容包括电工基础、电子技术、电力电子技术、电机学、计算机、电力系统、继电保护、发电厂、自动化等。书中内容参考了原版专业教材、专业期刊等，经改编而成。书中介绍了专业英语和科技英语的阅读、翻译知识、特点、难点和技巧，常见专业文体的写作知识。每章节配有综合练习，分为单元选题、回答问题和英译汉三类。

本书主要作为普通高等学校电气工程及其自动化专业的本科专业英语教材，也可作为高职高专电力技术类专业的专业英语教材，还可作为相关工程技术人员学习专业英语的参考用书。

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前　言

电气工程及其自动化专业是一个宽口径专业，它包含了许多专业方向，涉及较多专业领域。各本科院校在人才培养中，注重培养学生基础扎实，知识面广，素质高，能力强。英语水平高低已成为社会及企事业单位衡量和评价学生能力的标准之一。加强英语教学，尤其是专业英语教学，已经引起各高校的重视。

专业英语着重于培养学生对英文专业资料、文献和信息的阅读能力，培养学生专业写作能力，同时兼顾培养学生的专业英文听说能力。通过专业英语的学习，达到扩充学生的专业词汇量，熟练掌握科技英语和专业英语特点的教学目的。

针对电气工程及其自动化宽口径的专业特点，在教材内容选材上，编者力求内容覆盖面广，其中包括电工基础、电子技术、电力电子技术、电机学、计算机、自动化、电力系统、继电保护、发电厂等。课文内容参考了原版专业教材、专业期刊文章等，经改编而成。

在教材的每一章节穿插介绍了专业英语和科技英语的阅读、翻译知识、特点、难点和技巧。同时还介绍了专业英语和科技英语中的常见文体的写作知识，如个人简历、商务信函、产品说明书、学术论文等。

在内容编排上，每章节由五大块组成：原文（课文），生词、术语、词汇，课文难点注释，翻译、写作等知识，综合练习。综合练习分为三类：根据课文选择正确答案、根据课文回答问题、英译汉。

本书共有九章，第一、二、三、四章由山西大学工程学院王玲桃编写，第六、七、八章由华北电力大学顾雪平编写，第五、九章和每章节的翻译、写作等知识由山西大学工程学院苏小林编写，全书由苏小林统稿。山西大学工程学院郑仰成、赵萱教授负责审阅本教材，并提出了许多建设性意见，在此表示衷心感谢，同时也感谢山西大学工程学院的郭晓红、张海荣给予的支持和帮助。

由于编者的水平有限，书中难免存在不妥或错误之处，殷切期望广大读者批评指正。请将您的宝贵意见和建议寄往：山西大学工程学院电力工程系（030013）。

编　者

2008 年 03 月

Contents

Chapter 1 Fundamentals of Electric Circuits

Section 1 Current and Voltage

Two variables $u(t)$ and $i(t)$ are the most basic concepts in an electric circuit, they characterize the various relationships in an electric circuit.

Charge and Current

The concept of electric charge is the underlying principle for explaining all electrical phenomena. Also, the most basic quantity in an electric circuit is the electric charge. Charge is an electrical property of the atomic particles of which matter consists, measured in coulombs (C).

We know from elementary physics that all matter is made of fundamental building blocks known as atoms and that each atom consists of electrons, protons, and neutrons. We also know that the charge e on an electron is negative and equal in magnitude to 1.60210×10^{-19}C, while a proton carries a positive charge of the same magnitude as the electron. The presence of equal numbers of protons and electrons leaves an atom neutrally charged.

We consider the flow of electric charges. A unique feature of electric charge or electricity is the fact that it is mobile; that is, it can be transferred from one place to another, where it can be converted to another form of energy.

When a conducting wire is connected to a battery (a source of electromotive force), the charges are compelled to move; positive charges move in one direction while negative charges move in the opposite direction. This motion of charges creates electric current. It is conventional to take the current flow as the movement of positive charges, that is, opposite to the flow of negative charges, as Fig.1-1 illustrates. This convention was introduced by Benjamin Franklin (1706～1790), the American scientist and inventor. Although we now know that current in metallic conductors is due to negatively charged electrons, we will follow the universally accepted convention that current is the net flow of positive charges. Thus, Electric current is the time rate of charge, measured in amperes (A). Mathematically, the relationship among current i, charge q, and time t is

$$i=\frac{dq}{dt} \tag{1-1}$$

The charge transferred between time t_0 and t is obtained by integrating both sides of Eq. (1-1). We obtain

$$q=\int_{t_0}^{t} i\,dt \tag{1-2}$$

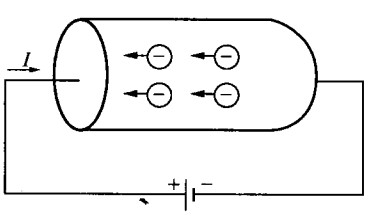

Fig.1-1 Electric current due to flow of electronic charge in a conductor

The way we define current as i in Eq. (1-1) suggests that current need not be a constant-valued function, charge can vary with time in several ways that may be represented by different kinds of mathematical functions.

Voltage, Energy, and Power

To move the electron in a conductor in a particular direction requires some work or energy transfer. This work is performed by an external electromotive force (emf), typically represented by the battery in Fig.1-1. This emf is also known as voltage or potential difference. The voltage u_{ab} between two points a and b in an electric circuit is the energy (or work) needed to move a unit charge from a to b; mathematically

$$u_{ab}=\frac{dw}{dq} \tag{1-3}$$

where w is energy in joules (J) and q is charge in coulombs (C). The voltage u_{ab} is measured in volts (V), named in honor of the Italian physicist Alessandro Antonio Volta (1745～1827), who invented the first voltaic battery. Thus, Voltage (or potential difference) is the energy required to move a unit charge through an element, measured in volts (V).

Fig.1-2 shows the voltage across an element (represented by a rectangular block) connected to points **a** and **b**. The plus (+) and minus (−) signs are used to define reference direction or voltage polarity. The u_{ab} can be interpreted in two ways: ①point **a** is at a potential of u_{ab} volts higher than point **b**; ②the potential at point **a** with respect to point **b** is u_{ab}. It follows logically that in general

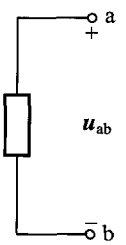

Fig.1-2 Polarity of voltage u_{ab}

$$u_{ab}=-u_{ba} \tag{1-4}$$

Although current and voltage are the two basic variables in an electric circuit, they are not sufficient by themselves. For practical purposes, we need to know *power* and energy. To relate power and energy to voltage and current, we recall from physics that power is the time rate of expending or absorbing energy, measured in watts (W). We write this relationship as

$$p=\frac{dw}{dt} \tag{1-5}$$

Where p is power in watts (W), w is energy in joules (J), and t is time in seconds (s). From Eq. (1-1), Eq. (1-3), and Eq. (1-5), it follows that

$$p=ui \tag{1-6}$$

Because u and i are generally function of time, the power p in Eq. (1-6) is a time-varying quantity and is called the instantaneous power. The power absorbed or supplied by an element is the product of the voltage across the element and the current through it. If the power has a plus sign, power is being delivered to or absorbed by the element. If, on the other hand, the power has a minus sign, power is being supplied by the element. But how do we know when the power has a negative or a positive sign?

Current direction and voltage polarity play a major role in determining the sign of power. It is therefore important that we pay attention to the relationship between current i and voltage u in Fig.1-3(a). The voltage polarity and current i direction must conform with those shown in Fig.1-3(a) in order for the power to have a positive sign. This is known as the passive sign convention. By the

passive sign convention, current enters through the positive polarity of the voltage. In this case, $p = ui$ or $ui > 0$ implies that the element is absorbing power. However, if $p = -ui$ or $ui < 0$, as in Fig.1-3(b), the element is releasing or supplying power.

In fact, the law of conservation of energy must be obeyed in any electric circuit. For this reason, the algebraic sum of power in a circuit, at any instant of time, must be zero

$$\Sigma p = 0 \qquad (1\text{-}7)$$

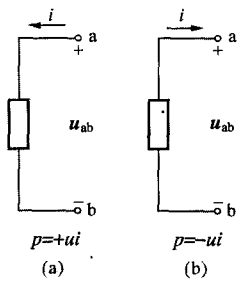

Fig.1-3 Reference polarities for power using the passive sign convention
(a) absorbing power; (b) supplying power

This again confirms the fact that the total power supplied to the circuit must balance the total power absorbed. From Eq. (1-7), the energy absorbed or supplied by an element from time t_0 to time t is

$$w = \int_{t_0}^{t} p\,dt \qquad (1\text{-}8)$$

New Words and Expressions

current	n. 电流
voltage	n. 电压
variable	n. 变量
charge	n. 电荷；v. 充电，带电，起电
coulomb	n. 库仑（电荷的单位）
circuit	n. 电路
underlying	a. ①基本的，根本的 ②潜在的，在下（面）的，下伏的
electron	n. 电子
positive charge	正电荷
negative charge	负电荷
magnitude	n. 大小，尺寸，数量，数值
electromotive	a. 电动的，起电的
electromotive force	电动势
ampere	n. 安，安培（电流的单位）
integrate	v. 积分，求积分
work	n. 功
potential difference	n. 电位差
rectangular	a. 矩形的，直角的，正交的
joule	n. 焦尔（能量、热量、功的单位）
volt	n. 伏特（电压、电位、电势的单位）
voltaic battery	伏达电池
convention	n. 习惯，惯例，常规

reference direction	参考方向
polarity	n. 极性
power	n. ①功率，效率 ②动力，电力，能力，电源 ③乘方，幂
watt	n. 瓦特（功率的单位）
time-varying	a. 时变的
instantaneous power	瞬时功率
passive	a. ①无源的 ②消极的，被动的；n. 无源
algebraic	a. 代数的
instant	n. 瞬间，瞬时，即刻，时，时刻

Notes

1. Charge is an electrical property of the atomic particles of which matter consists, measured in coulombs.
   电荷是构成物质的原子的电气属性，其量纲为库仑。
2. The presence of equal numbers of protons and electrons leaves an atom neutrally charged.
   质子和电子数量相同使得原子呈现电中性。leave 在此作“使，让”讲。
3. The voltage u_{ab} between two points a and b in an electric circuit is the energy (or work) needed to move a unit charge from a to b.
   电路中 a、b 两点间电压 u_{ab} 等于从 a 到 b 移动单位电荷所需能量（或所需做的功）。

专业英语概述

随着科学技术的发展、社会的进步，各国之间技术信息、学术交流和专业技术情报传播日益广泛。我国加入 WTO 后，与世界各国在电气工程及其自动化领域的技术合作、交流、竞争日益频繁，各类英文技术情报资料、专业技术文献、工程设备文档资料等大量涌现。因此，电气工程及其自动化专业领域的工作者必须具备良好的基础英语能力和专业英语能力，才能高效、快速、准确地吸收最新技术情报和开展国际科学技术交流，才能跟上该专业领域的技术发展。

电气工程及其自动化专业英语是英语在电气工程及其自动化专业领域的应用，因此专业英语是以基础英语作为基础。为了体现科学技术资料的客观、科学、精确和准确，专业英语与基础英语有着很大的差别，其文章的结构具有如下特点：

（1）长句多，有时甚至一个段落只有一个句子；

（2）大量使用被动语态和非谓语动词；

（3）介词短语多；

（4）名词性词组多；

（5）使用虚拟语气的句子多；

（6）专业术语、合成新词及半技术词汇多。

专业英语以其独特的语体，明确地表达作者在其专业方面的见解，表达方式直截了当，具有准确、精练、正式、逻辑性强的特点，注重客观事实和真理。专业英语属于科技英语的范畴，具有科技英语的特点，与专业内容联系紧密，专业性强。例如，同一个词在不同学科的专业英语中，

其涵义可能不同。不同学科的专业英语有着各自的特点。

通过专业英语的学习，不仅要扩充、掌握大量的专业词汇，还要熟悉专业英语的词法、句法的特点，提高专业英语的阅读理解能力、翻译能力和写作能力。

要正确地理解专业英语文献资料，并准确地用汉语表达，除了要求我们熟练地运用汉语表达方式外，还要具有一定的专业知识和专业水平，注重与专业内容联系，使用规范的专业术语。

Exercises

I. Choose the best answer into the blank

1. It is conventional to take the current flow as the movement of _____.
   A. negative charges B. positive charges C. any charge D. protons
2. Electric current is the time rate of charge, measured in _____.
   A. watts B. volts C. joules D. amperes
3. The energy required to move a unit charge through an element is _____.
   A. current B. power C. voltage D. potential
4. The plus (+) and minus (−) signs in an electric circuit diagram are used to define _____.
   A. voltage polarity B. current direction C. power flow D. absorbed power
5. According to the passive sign convention, if the power has a plus sign, power is _____ by the element.
   A. supplied B. absorbed C. generated D. transferred

II. Answer the following questions according to the text

1. Is current in any electric circuit always a constant-valued function? Why?
2. How does current change when the time rate of charges is greater?
3. How to interpret the $u_{ab} = -1$ volt in two ways?
4. What relation is between power and energy?
5. Why do current direction and voltage polarity play a major role in determining the characteristics of power?

Section 2 Circuit Elements

An electric circuit is simply an interconnection of the elements. There are two types of elements found in electric circuits: passive elements and active elements. An active element is capable of generating energy while a passive element is not. Examples of passive elements are resistors, capacitors, and inductors. The most important active elements are voltage or current sources that generally deliver power to the circuit connected to them.

Independent sources

An ideal independent source is an active element that provides a specified voltage or current that is completely independent of other circuit variables.

An independent voltage source is a two-terminal element, such as a battery or a generator, which maintains a specified voltage between its terminals. The voltage is completely independent of the current through the element. The symbol for a voltage source having u volts across its terminals is shown in Fig.1-4(a). The polarity is as shown, indicating that terminal a is u volts above terminal b. Thus if $u > 0$, then terminal a is at a higher potential than terminal b. The opposite is true, of course, if $u < 0$.

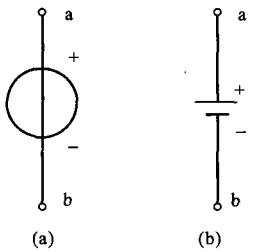

Fig.1-4 Symbols for independent voltage sources
(a) used for constant or time-varying voltage;
(b) used for constant voltage (dc)

In Fig.1-4(a), the voltage u may be time varying, or it may be constant, in which case we would probably label it U. Another symbol that is often used for a constant voltage source, such as a battery with U volts across its terminals, is shown in Fig.1-4(b). In the case of constant sources we shall use Fig.1-4(a) and 1-4(b) interchangeably.

We might observe at this point that the polarity marks on Fig.1-4(b) are redundant since the polarity could be defined by the positions of the longer and shorter lines.

An independent current source is a two-terminal element through which a specified current flows. The current is completely independent of the voltage across the element. The symbol for an independent current source is shown in Fig.1-5, where i is the specified current. The direction of the current is indicated by the arrow.

Independent sources are usually meant to deliver power to the external circuit and not to absorb it. Thus if u is the voltage across the source and its current i is directed out of the positive terminal, then the source is delivering power, given by $p = ui$, to the external circuit. Otherwise it is absorbing power. For example, in Fig.1-6 (a) the battery is delivering 24 W to the external circuit. In Fig.1-6(b) the battery is absorbing 24 W, as would be the case when it is being charged.

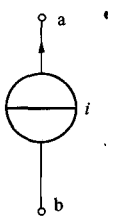

Fig.1-5 Symbols for independent current sources

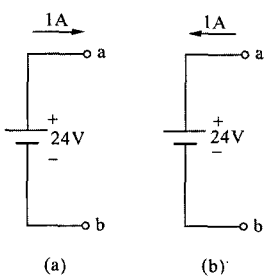

Fig.1-6 Symbols for independent sources
(a) A source delivering power; (b) A source absorbing power

Dependent sources

An ideal dependent (or controlled) source is an active element in which the source quantity is controlled by another voltage or current.

Dependent sources are usually designated by diamond-shaped symbols, as shown in Fig.1-7. Since the control of the dependent source is achieved by a voltage or current of some other element in the circuit, and the source can be voltage or current, it follows that there are four possible types of dependent sources, namely:

（1）A voltage-controlled voltage source (VCVS).

（2）A current-controlled voltage source (CCVS).

（3）A voltage-controlled current source (VCCS).

（4）A current-controlled current source (CCCS).

Dependent sources are useful in modeling elements such as transistors, operational amplifiers and integrated circuits.

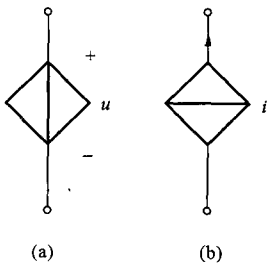

Fig.1-7 Symbols for dependent sources
(a) Dependent voltage source; (b) Dependent current source

It should be noted that an ideal voltage source (dependent or independent) will produce any current required to ensure that the terminal voltage is as stated, whereas an ideal current source will produce the necessary voltage to ensure the stated current flow. Thus an ideal source could in theory supply an infinite amount of energy. It should also be noted that not only do sources supply power to a circuit, but they can absorb power from a circuit too. For a voltage source, we know the voltage but not the current supplied or drawn by it. By the same token, we know the current supplied by a current source but not the voltage across it.

New Words and Expressions

active	a. ①有源的，有功的，有效的 ② 活动的，主动的，积极的 ③活性的，放射的，激励的
active element	有源元件
resistor	n. 电阻，电阻器
capacitor	n. 电容器
inductor	n. 电感器
source	n. 电源，（光，能，动力，信号，辐射，根，来，起）源
ideal independent source	理想独立源
generator	n. ①发电机 ②（脉冲，信号，气体）发生器，振荡器，加速器
constant voltage source	恒定电压源
independent source	独立源
dependent source	受控源
controlled source	受控源
diamond-shaped	a. 菱形的
voltage-controlled voltage source	电压控制电压源
current-controlled voltage source	电流控制电压源
voltage-controlled current source	电压控制电流源

current-controlled current source	电流控制电流源
transistor	n. 晶体管，半导体管
operational	a. ①运算的，计算的 ②操作的，工作的，业务的，运转的
amplifier	n. 放大器
integrated circuit	集成电路
token	n. ①标记，象征，记号 ②特征，证明
by the same token	同理，同样；另外，还有

Notes

1. In Fig.1-6(b) the battery is absorbing 24 W, as would the case when it is being charged.
图 1-6 中，电池就像充电情况，吸收功率 24W。
2. It should be noted that an ideal voltage source (dependent or independent) will produce any current required to ensure that the terminal voltage is as stated, whereas an ideal current source will produce the necessary voltage to ensure the stated current flow.
应该注意：一个理想电压源（独立或受控）可向电路提供任意电流以保证其端电压为规定值，而电流源可向电路提供任意电压以保证其规定电流。

翻 译 标 准

翻译既与阅读有关，又有很大不同。阅读专业外文资料，只要自己能看懂，正确理解其内容即可，不涉及用一种语言文字表达的问题。而翻译的任务是要把一种语言表达的内容，完整而正确地用另一种语言表达出来。由于英语和汉语在语言规则和习惯上各不相同，各有特点，在词汇和语法上也有着很大差异。在翻译过程中，要做到使原文的内容准确而通顺地表达清楚，在用词造句上就必须符合汉语的表达规则和习惯。

专业英语翻译是对原文的一种再创作过程，译者不仅需要有较好的相关专业知识，还需要不断探索和掌握翻译的内在规律，才能做好这项工作。对于专业英语翻译，应达到“准确明白”、“通顺严密”、“简练全面”这三项标准。

（1）准确明白，一是指要准确无误地表达原文的含义，不得有错误和遗漏之处，在技术内容上要忠实原文；二是要清楚明白地表达原文的意思，不得有模糊不清、模棱两可之处。要达到这一标准，首先要深刻地、正确地理解原文，其次在组织译文时要注意避免歧义。

（2）通顺严密，是指译文应当合乎中文的语法要求，语句流畅，使读者阅读易懂；同时又应严密，不能因通顺而牺牲了原文的严密性，损害了原文的内容。要达到这一标准，一是选词造句正确，二是语气表达正确。

（3）简练全面，是指译文要尽可能简短、精练，没有冗词费字，同时不要有任何遗漏。要达到这一标准，需在翻译时不受原文结构的限制，利用适当的转换译法，力求译文简洁明快、精练流畅。

专业英语翻译人员为达到以上三条标准，需做到以下几点要求：

（1）掌握英语语法知识。包括词法、句法和各种习惯用法。在翻译过程中，通过英语语法分

析，有利于正确地理解原文。所以，需要不断地学习和掌握英语语法，提高英语水平。

（2）具有一定深度的专业知识和较为广博的科学知识。只有较为深入地掌握了专业知识，才能在翻译过程中，正确地理解原文的专业技术内容，并能使用正确的专业术语。由于学科之间的联系越来越紧密，交叉内容也越来越多，因此，还需要广泛了解其他有关学科的一般常识。

（3）有较高的汉语修养。即能较为熟练地运用汉语的语法修辞手段来准确地表达原文的技术内容。

（4）掌握翻译方法和技巧。即熟悉英语各种常见句型、短语、词汇的不同翻译方法和技巧，在翻译过程中才能较为得心应手地进行翻译。

Exercises

I. Choose the best answer into the blank

1. An independent voltage source is a _____, which maintains a specified voltage between its terminals.
   A. one-terminal element　　B. two-terminal element
   C. three-terminal element　　D. four-terminal element
2. Resistors are _____ elements.
   A. passive　　B. active
   C. independent source　　D. dependent source
3. An ideal dependent source is an _____ element in which the source quantity is controlled by another voltage or current.
   A. passive　　B. active
   C. independent　　D. inductive
4. There are _____ possible types of dependent sources.
   A. two　　B. three
   C. four　　D. five
5. For a voltage source, its terminal voltage is known but its _____ must be determined by the external circuit connecting with it.
   A. electromotive force　　B. current
   C. control coefficient　　D. polarity

II. Answer the following questions according to the text

1. What difference is there between an independent source and a dependent source?
2. What element is an ideal independent source?
3. Is the voltage of an independent voltage source dependent of the current through the element? How to find the current through it?
4. What are four possible types of dependent sources?
5. Is the terminal voltage of independent voltage source always constant?

III. Translate the following into Chinese

All the simple circuit elements that will be considered in the work that follows can be