高等学校专业英语教材

自动化与电子信息专业英语

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内 容 简 介

本书主要针对自动化、电气控制和电子信息等专业的本科生阅读和翻译英文文献资料的需要而编写，选编的文献资料涵盖了电工、电子电路、电子电气设备器件、传感技术、微机原理、控制理论、计算机控制等从基础理论到实际运用的广泛内容。所有文献均出自海外原文资料。除了提供专业词汇和难句注释分析外，还为读者提供了所有课文的参考译文。绝大多数课文后还提供了课外阅读材料。除了教材、论文这些最常见的文体外，还有技术说明、产品使用及科技交流、宣传等多种文体，目的在于使读者能够多方面接触各种不同类型的英文资料。所有这些编排都十分有利于读者深入学习理解原文，提高阅读和翻译能力。

本书不仅适合电类专业本科生及研究生使用，也适合广大相关工程专业的技术人员参考。

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前　言

根据目前高等院校自动化、电气工程及其自动化及电子信息工程等专业有关课程教学大纲的要求，我们组织编写了本书。

本书共计 7 个部分 48 个单元。各单元主要由课文、专业词汇、注释和参考译文几部分组成。除第七部分外，课文均选自相关专业英文原版大学教材、专业文献。第七部分亦源自海外实际材料。课程内容覆盖相关电类专业从技术基础到专业的发展、理论和应用；文体涉及教材、论文、技术说明书及应用文等，以期让读者尽可能广泛地接触到各种与专业有关的资料。绝大部分课程附有课外阅读，有助于读者提高独立阅读能力。

本书由武汉工业学院的几位教师和辽宁工程技术大学的董桂红老师编写。他们在专业教学科研、对外交流、专业英语教学方面各有所长，有利于本书的编写。杨植新担任主编，主持本书编写大纲的制订及全书统稿工作，并编写了第二部分的第 7 单元、第四部分的第 1～4 单元和第 6 单元、第五部分的第 4 单元和第 5 单元及第七部分，第三部分由杨植新和董桂红共同编写；周劲任副主编，编写了第一部分及第六部分；孙江波编写了第二部分的第 1～6 单元和第 8、9 单元；李素芬编写了第四部分的第 5、7 单元及第五部分的第 1～3 单元。本书编写过程中，在收集资料时得到了周玉女士的热情帮助，谨表谢意。

本书提供配套的电子课件，可登录电子工业出版社的华信资源教育网 www. huaxin. edu. cn 或 www. hxedu. com. cn，注册后免费下载。

鉴于作者水平有限，加之时间仓促，书中疏漏不妥之处在所难免，敬希专家及读者赐教指正。

CONTENTS

Part 1 Fundaments of Electric Circuits

1.1 Circuit concepts

1.1.1 Text

Passive and Active Elements

An electrical device is represented by a circuit diagram or network constructed from series and parallel arrangements of two-terminal elements. The analysis of the circuit diagram predicts the performance of the actual device. A two-terminal element in general form is shown in Figure 1.1.1, with a single device represented by the rectangular symbol and two perfectly conducting leads ending at connecting points A and B[1]. Active elements are voltage or current sources which are able to supply energy to the network. Resistors, inductors, and capacitors are passive elements which take energy from the sources and either convert it to another form or store it in an electric or magnetic field.

Figure 1.1.1 A two-terminal element in general form.

Fig 1.1.2 illustrates seven basic circuit elements. Elements (a) and (b) are voltage sources and (c) and (d) are current sources. A voltage source that is not affected by changes in the connected circuit is an independent source, illustrated by the circle in Figure 1.1.2(a). A dependent voltage source which changes in some described manner with the conditions on the connected circuit is shown by the diamond-shaped symbol in Figure 1.1.2(b). Current sources may also be either independent or dependent and the corresponding symbols are shown in (c) and (d). The three passive circuit elements are shown in Figure 1. 1.2(e), (f), and (g).

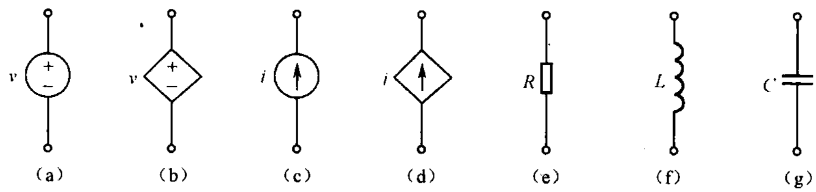

Figure 1.1.2 Seven basic circuit elements.

The circuit diagrams presented here are termed lumped-parameter circuits, since a single element in one location is used to represent a distributed resistance, inductance, or capacitance[2]. For example, a coil consisting of a large number of turns of insulated wire has resistance throughout the entire length of the wire. Nevertheless, a single resistance lumped at one place as in Figure 1.1.3(b) or (c) represents the distributed resistance. The inductance is likewise lumped at one place, either in series with the resistance as in (b) or in parallel as in (c).

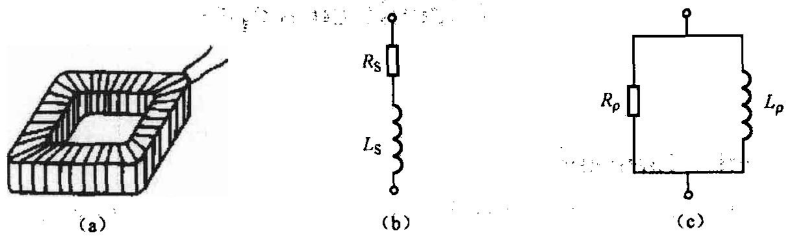

Figure 1.1.3 (a) A coil; (b) A single resistance; (c) The distributed resistance.

In general, a coil can be represented by either a series or a parallel arrangement of circuit elements. The frequency of the applied voltage may require that one or the other be used to represent the device.

Sign Conventions

A voltage function and a polarity must be specified to completely describe a voltage source. The polarity marks, + and −, are placed near the conductors of the symbol that identifies the voltage source. If, for example, $v = 10.0\sin\omega t$ in Figure 1.1.4(a), terminal A is positive with respect to B for $0 > \omega t > \pi$, and B is positive with respect to A for $\pi > \omega t > 2\pi$ for the first cycle of the sine function.

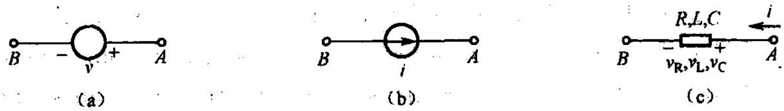

Figure 1.1.4 A Voltage Source, a current source and passive circuit element.

Similarly, a current source requires that a direction be indicated, as well as the function, as shown in Figure 1.1.4(b) [3]. For passive circuit elements R, L and C, shown in Figure 1.1.4(c), the terminal where the current enters is generally treated as positive with respect to the terminal where the current leaves.

The sign on power is illustrated by the DC circuit of Figure 1.1.5(a) with constant voltage sources $V_A = 20.0$ V and $V_B = 5.0$ V and a single 5 Ω resistor. The resulting current of 3.0 A is in the clockwise direction. Considering now Figure 1.1.5(b), power is absorbed by an element when the current enters the element at the positive terminal. Power, computed by VI or I^2R, is therefore absorbed by both the resistor and the V_B source, 45.0 W and 15 W respectively. Since the current enters V_A at the negative terminal, this element is the power source for the circuit. $P = VI = 60.0$ W confirms that the power absorbed by the resistor and the source V_B is provided by the source V_A.

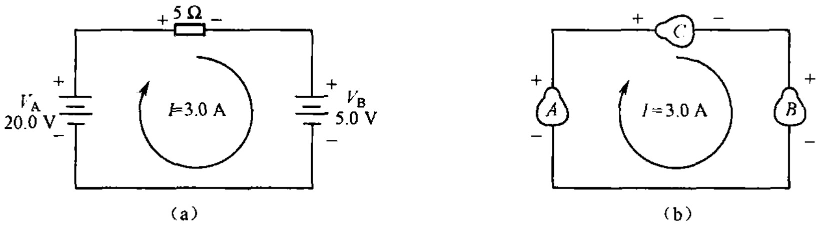

Figure 1. 1. 5 DC Circuit and its current direction.

Voltage-Current Relations

The passive circuit elements resistance R, inductance L, and capacitance C are defined by the manner in which the voltage and current are related for the individual element. For example, if the voltage v and current i for a single element are related by a constant, then the element is a resistance, R is the constant of proportionality, and $v = Ri$. Similarly, if the voltage is the time derivative of the current, then the element is an inductance, L is the constant of proportionality, and $v = L\mathrm{d}i/\mathrm{d}t$. Finally, if the current in the element is the time derivative of the voltage, then the element is a capacitance, C is the constant of proportionality, and $i = C\mathrm{d}v/\mathrm{d}t$. Table 1. 1. 1 summarizes these relationships for the three passive circuit elements. Note the current directions and the corresponding polarity of the voltages.

Table 1. 1. 1 The voltage-current relationships for the three passive circuit elements.

Circuit element	Units	Voltage	Current	Power
+ v − i Resistance	ohms (Ω)	$v = Ri$	$i = \dfrac{v}{R}$	$p = vi = i^2R$
i + v − Inductance	henries(H)	$v = L\dfrac{\mathrm{d}i}{\mathrm{d}t}$	$i = \dfrac{1}{L}\int v\mathrm{d}t + k_1$	$p = vi = Li\dfrac{\mathrm{d}i}{\mathrm{d}t}$
+ v − i Capacitance	farads (F)	$v = C\int i\mathrm{d}t + k_2$	$i = C\dfrac{\mathrm{d}v}{\mathrm{d}t}$	$p = vi = Cv\dfrac{\mathrm{d}v}{\mathrm{d}t}$

Resistance

All electrical devices that consume energy must have a resistor (also called a resistance) in their circuit model. Inductors and capacitors may store energy but over time return that energy to the source or to another circuit element. Power in the resistor, given by $p = vi = i^2R = v^2/R$, is always positive. Energy is then determined as the integral of the instantaneous power

$$w = \int_{t_1}^{t_2} p\mathrm{d}t = R\int_{t_1}^{t_2} i^2\mathrm{d}t = \frac{1}{R}\int_{t_1}^{t_2} v^2\mathrm{d}t$$

Inductance

The circuit element that stores energy in a magnetic field is an inductor (also called an inductance). With time-variable current, the energy is generally stored during some parts of the cycle and then returned to the source during others. When the inductance is removed from the source, the magnetic field will collapse; in other words, no energy is stored without a connected source. Coils found in electric motors, transformers, and similar devices can be expected to have inductances in their circuit models. Even a set of parallel conductors exhibits inductance that must be considered at most frequencies. The power and energy relationships are as follows.

$$p = vi = L\frac{\mathrm{d}i}{\mathrm{d}t} = \mathrm{d}t\left[\frac{1}{2}Li^2\right]$$

$$w_\mathrm{L} = \int_{t_1}^{t_2} p\mathrm{d}t = \int_{t_1}^{t_2} Li\,\mathrm{d}t = \frac{1}{2}L[i_2^2 - i_1^2]$$

Energy stored in the magnetic field of an inductance is $w_\mathrm{L} = \frac{1}{2}Li^2$.

Capacitance

The circuit element that stores energy in an electric field is a capacitor (also called capacitance). When the voltage is variable over a cycle, energy will be stored during one part of the cycle and returned in the next. While an inductance cannot retain energy after removal of the source because the magnetic field collapses, the capacitor retains the charge and the electric field can remain after the source is removed. This charged condition can remain until a discharge path is provided, at which time the energy is released. The charge, $q = Cv$, on a capacitor results in an electric field in the dielectric which is the mechanism of the energy storage[4]. In the simple parallel-plate capacitor there is an excess of charge on one plate and a deficiency on the other. It is the equalization of these charges that takes place when the capacitor is discharged[5]. The power and energy relationships for the capacitance are as follows.

$$p = vi = Cv\frac{\mathrm{d}v}{\mathrm{d}t} = \frac{\mathrm{d}}{\mathrm{d}t}\left[\frac{1}{2}Cv^2\right]$$

$$w_\mathrm{C} = \int_{t1}^{t_2} p\mathrm{d}t = \int_{t_1}^{t_2} Cv\mathrm{d}v = \frac{1}{2}C[v_2^2 - v_1^2]$$

The energy stored in the electric field of capacitance is $w_\mathrm{C} = \frac{1}{2}Cv^2$.

Circuit Diagrams

Every circuit diagram can be constructed in a variety of ways which may look different but are in fact identical. The diagram presented in a problem may not suggest the best of several methods of solution. Consequently, a diagram should be examined before a solution is started and redrawn if necessary to show more clearly how the elements are interconnected. An extreme example is illustrated in Figure 1.1.6, where the three circuits are actually identical. In Figure 1.1.6(a) the three "junctions" labeled A are shown as two "junctions" in (b). However, resistor R_4 is bypassed by a short circuit and may be removed for purposes of analysis. Then, in Figure 1.1.6(c) the single junction A is shown with its three meeting branches.

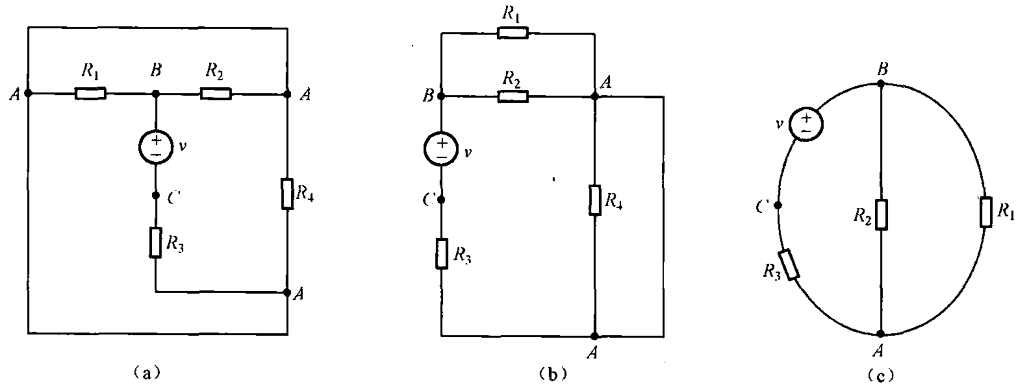

Figure 1.1.6 An extreme example that the three circuits are actually identical.

1.1.2 Specialized English Words

electrical device 电气元件
conducting lead 引线体
resistor 电阻器
resistance 电阻,阻值
inductor 电感器
capacitor 电容器
capacitance 电容
passive elements 无源元件
active elements 有源元件
illustrate 图解
circuit diagram 电路图
lumped-parameter circuits 集总参数电路
lumped 集总的
sign 符号
power 功率
sine 正弦
polarity 极性
energy 能量

instantaneous 瞬时的
magnetic field 磁场
time-variable 时变的
coil 线圈
electric motor 电动机
transformers 变压器
dielectric 电介质
mechanism 机理
paralleled-plate 平行板
charges 电荷
deficiency 缺乏,不足
equalization 均衡,同等化
junction 节点
term 术语
distributed 分布式的
cycle 周期
derivative 导数

1.1.3 Notes

[1]A two-terminal element in general form is shown in Figure 1.1.1, with a single device represented by the rectangular symbol and two perfectly conducting leads ending at connecting points *A* and *B*. 句中“with…”为介词短语作状语修饰“is shown”。此句可译为“二端元件的一般形式如图 1.1.1 所示，它是用长方形符号及以 *A*,*B* 为端点的两段理想引线导体来表示的。”

[2]The circuit diagrams presented here are termed lumped-parameter circuits, since a single element in one location is used to represent a distributed resistance, inductance, or capacitance. 句中“since”后面为原因状语从句，用来说明前面的主句。此句可译为“由于我们常用位于某处单个元件来表示分布电阻、电感或电容，所以这里所列出的这些电路图称为集总参数电路。”

[3]Similarly, a current source requires that a direction be indicated, as well as the function, as shown in Figure 1.1.4(b). “as well as” 在句中作为并列连词在科技英语中很常见，这里表示后面的“function”和前面的“direction”一样需要指明。此句可译为“与电压源类似，电流源也需要指明其方向和函数，如图 1.1.4(b)所示。”

[4]The charge, $q = Cv$, on a capacitor results in an electric field in the dielectric which is the mechanism of the energy storage. 句中“results in” 短语表示导致，造成……结果。“which” 引导的非限定性定语从句用来修饰前面的整个句子。此句可译为“电容器中的电荷，$q = Cv$ ，在电介质中产生电场，这便是电容器储存能量的机理。”

[5]It is the equalization of these charges that takes place when the capacitor is discharged. 句中“It is…that” 为强调句型，强调主语“the equalization of these charges”。此句可译为“当电容放电时，两极板上的电荷趋向均衡。”

1.1.4 Reference Translation

电路基本概念

无源元件与有源元件

电气元件是用电路图或网络来描述的，它们由串联或并联连接的两端元件组成。对电路图的分析可预估实际器件的性能。二端元件的一般形式如图 1.1.1 所示，它是用长方形符号及以 *A*,*B* 为端点的两段理想引线体来表示的。有源元件是指能向电路网络提供能量的电压源或电流源。电阻、电感和电容是无源元件，它们吸收电源能量，并将这些能量转化为其他形式或将它存储在电场或磁场中。

图 1.1.2 列举了七种基本电路元件。元件(a)和(b)是电压源，(c)和(d)是电流源。图 1.1.2(a)所示圆圈表示的是独立电压源，它不受所连接电路变化的影响。受控电压源随所连接电路中描述的条件按一定的方式变化，以图 1.1.2(b)所示的菱形表示。电流源也分为独立电流源和受控电流源，相应的符号分别示于(c)和(d)。图 1.1.2(e)、(f)和(g)所示为三种无源电路元件的符号。