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普通高等学校

自动化类专业新编系列教材

Specialized English For Automation

自动化专业英语

戴文进 章卫国 主编

武汉理工大学出版社

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内 容 提 要

本书主要讨论自动化类专业英语的阅读与翻译。全书分四部分，共计四十五课，每课含英语原文课文、专业英语词汇、课文注释和参考译文四部分内容。专业内容涵盖电工电子、计算机控制及仪器仪表、经典的与现代的控制理论与控制技术等。

本书系普通高等学校自动化类专业（本科）新编系列教材，也可供有关技术人员参考。

图书在版编目(CIP)数据

自动化专业英语/戴文进、章卫国主编. —武汉：武汉理工大学出版社，2001.8
普通高等学校自动化类专业新编系列教材
ISBN 7-5629-1720-5

Ⅰ.自…
Ⅱ.①戴…②章…
Ⅲ.自动化技术-英语-高等学校-教材
Ⅳ.H31

出版发行：武汉理工大学出版社
武汉市武昌珞狮路 122 号　邮政编码 430070
HTTP://www.whut.edu.cn/chuban1
E-mail:wutp@public.wh.hb.cn
经 销 者：各地新华书店
印 刷 者：武汉市科普教育印刷厂印刷
开　　本：787×1092　1/16
印　　张：23
字　　数：598 千字
版　　次：2001 年 8 月第 1 版
印　　次：2001 年 8 月第 1 次印刷
印　　数：1—5 000 册
定　　价：29.50 元
凡购本书，如有缺页、倒页、脱页等印装质量问题，请向出版社发行部调换
本社购书热线电话：(027)87397097　87394412

普通高等学校自动化类专业新编系列教材

出版说明

世纪之交，我国高等学校的人才培养工作正处在一个关键的历史时期。为了适应我国改革开放和社会主义现代化建设特别是社会主义市场经济体制对高等教育人才培养工作的新要求，为了适应世界科学技术发展的新趋势和新特点，原国家教育委员会组织对普通高等学校本科专业目录进行了第四次全面修订，并于1998年7月由教育部正式颁布实施。修订后的专业目录中，自动化类专业的专业面大大拓宽，相应的专业培养目标、业务培养要求、主干学科、主要课程、主要实践性教学环节等都有了不同程度的变化。要适应新的专业培养目标和教学要求，组织一套新的自动化类专业系列教材就成了当务之急。为此，武汉理工大学出版社在广泛调研的基础上，组织国内近30所大学的近100位教授共同编写了这套系列教材。

本套教材定位于普通高等学校自动化类专业本科层次，遵照教育部颁发的《普通高等学校本科专业介绍》中所提出的培养目标和培养要求，依据2000年5月全国23所高等院校的70多位专家教授在武汉共同确定的指导思想和编写大纲进行编写，具有如下特点：

观念新——主动适应教学改革的需要和市场经济对人才培养的要求；

内容新——自动化技术在近20年来进展巨大，并与计算机技术、航空航天技术、建筑工程、生物工程、社会科学（社会系统与经济系统）联系越来越紧密，这套教材尽可能反映了这些内容，以适应21世纪自动化与控制工程人才的培养要求；

体系新——在以前的基础上重构和重组，而非重建。各门课程及内容的组成、顺序、比例更加优化，避免遗漏和不必要的重复；

与国际接轨——自动化类专业教育要面向世界，面向未来，面向区域经济。在借鉴发达国家高等教育的专业模式和课程设置的同时，适当兼顾当前各地区经济文化发展不平衡的现状；

教学手段现代化——本套教材力求具有网络化、电子化、数字化的特色，大力推进电子讲稿和多媒体课件的出版工作。

本系列教材是在21世纪初推出的目前系统优化、品种较全、作者阵容最强的一套普通高等学校自动化类（本科）系列教材。我们将高度重视，兢兢业业，保证质量，恳请选用本套教材的广大师生在使用过程中给我们多提意见和建议，以便我们不断修订、补充、完善全套教材。

21世纪已经到来，知识经济的曙光已经初现。面向新世纪的中国高等教育正在经历前所未有的变革和发展，人文与理工相通，科学与技术相融，教学与研究并重，知识与智慧同尊，以培养社会经济文化发展所需要的复合型人才，这是我国建立知识创新体系的重大挑战和空前机遇。我社愿与各位专家、读者真诚合作，共同努力，为新世纪的中国高等教育事业做出更大的贡献。

武汉理工大学出版社

2001年8月

普通高等学校自动化类专业新编系列教材

编审委员会

前　言

根据普通高等学校自动化类专业(本科)新编系列教材编委会的总体要求精神,遵照"自动化专业英语"课程的教学大纲要求,依据编委会审定通过的"自动化专业英语"教材编写大纲,我们编写了本书。

本书分四部分,共计四十五课。课文中的英语原文全部选自英语原版大学教材、各类文献及仪器仪表说明书等。随后列出了文中出现的专业词汇,以备学习中积累专业词汇之用。其次对课文进行了注释,就课文中出现的语法现象进行了分析和讲解,并就所涉及到的英语阅读和翻译方法与技巧进行了讲述,以期提高学生的阅读与翻译能力。最后提供了整篇课文的参考译文,以便学生阅读和翻译时借鉴与参考。

本书由南昌大学戴文进教授和西北工业大学章卫国教授任主编。戴文进主持制订了本书的编写大纲,对全书进行了统稿,并具体编写了第一部分(即前十二课)和附录二、附录三及附录四。章卫国编写了第三部分(即第二十五课至三十六课)及附录一。宁波大学胡超副教授和南京化工大学张湜副教授参加了本书的编写工作。胡超编写了第二部分(即第十三课至二十四课),张湜编写了第四部分(即第三十七课至四十五课)。

本书由南昌大学外语学院董史良教授任主审。董教授对全书进行了认真审阅,提出了许多宝贵意见,并与戴文进主编一道参与了改稿工作,付出了辛勤劳动。在此,我们表示衷心的感谢。

在本书的编写过程中,南昌大学青年教师魏平、韩秀清、徐龙权、陈瑛和章景明,在校硕士生叶琦娅、余李、李庆武等也做出了大量工作,参与了资料收集、内容整理、文字录入、插图绘制以及书稿的校对工作,在此也一并致谢。

由于编者水平有限,加之时间仓促,书中恐有不少疏漏和不当之处,请读者不吝指教,我们将不胜感激。

编　者

2001 年 2 月

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Part 1

Electrics and Electronics

Unit 1

1.1 Text

Circuit Elements and Parameters

An electric circuit(or network)is an interconnection of physical electrical devices. The purpose of electric circuits is to distribute and convert energy into some other forms. Accordingly, the basic circuit components are an energy source(or sources), an energy converter(or converters), and conductors connecting them.

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. An energy converter, also called load(such as a lamp, heating appliance, or electric motor), converts electric energy into light, heat, mechanical work, and so on.

Events in a circuit can be defined in terms of e. m. f. (or voltage)and current. When electric energy is generated, transmitted and converted under conditions such that the currents and voltages involved remain constant with time, one usually speaks of direct-current (D. C.) circuits.

With time-invariant currents and voltages, the magnetic and electric fields of the associated electric plant are also time-invariant. This is the reason why no e. m. f. s of self- or mutual-induction appear in D. C. circuits, nor are there any displacement currents in the dielectric surrounding the conductors.

Fig 1. 1 shows in simplified form a hypothetical circuit with a storage battery as the source and a lamp as the load. The terminals of the source and load are interconnected by conductors (generally but not always wires). As is seen, the source, load and conductors form a closed conducting path. The e. m. f. of the source causes a continuous and unidirectional current to circulate round this closed path.

This simple circuit made up of a source, a load and two wires is seldom, if ever, met with in practice. Practical circuits may contain a large number of sources and loads interconnected in a variety of ways.

To simplify analysis of actual circuits, it is usual to show them symbolically in a diagram called a circuit diagram, which is in fact a fictitious or, rather, idealized model of an actual circuit or network. Such a diagram consists of interconnected symbols called circuit elements or circuit parameters. Two elements are necessary to represent processes in a D. C. circuit. These are a source of e. m. f. E and of internal(or "source") resistance R_S, and the load resistance(which includes the resistance of the conductors) R(Fig. 1. 2).

Whatever its origin(thermal, contact, etc.), the source e. m. f. E(Fig. 1. 2(a))is numerically equal to the potential difference between terminals 1 and 2 with the external circuit open, that is, when there is no current flowing through the source:

$$E = \varphi_1 - \varphi_2 = V_{12} \quad (1.1)$$

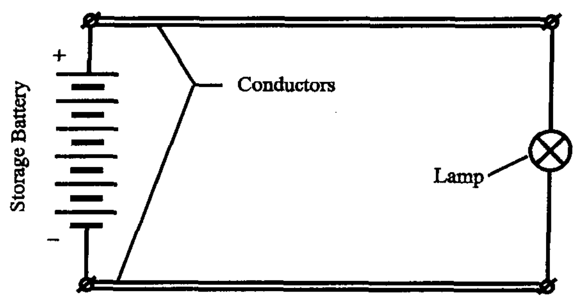

Fig. 1. 1

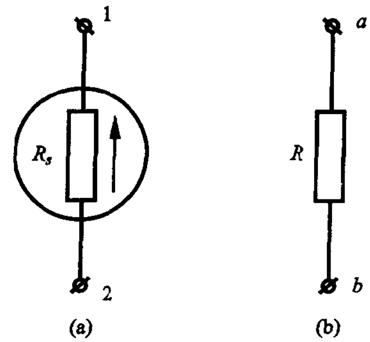

Fig. 1. 2

The source e. m. f. is directed from the terminal at a lower potential to that at a higher one. In diagram, this is shown by arrows.

When a load is connected to the source terminals (the circuit is then said to be loaded) and the circuit is closed, a current begins to flow round it. Now the voltage between source terminals 1 and 2 (called the terminal voltage) is not equal to its e. m. f. because of the voltage drop V_S inside the source, that is, across the source resistance R_S

$$V_S = R_S I$$

Fig. 1. 3 shows a typical so-called external characteristic $V_{12} = \varphi_1 - \varphi_2 = V(I)$ of a loaded source (hence another name is the load characteristic of a source). As is seen, increase of current from zero to $I \approx I_1$ causes the terminal voltage of the source to decrease linearly

$$V_{12} = V = E - V_S = E - R_S I$$

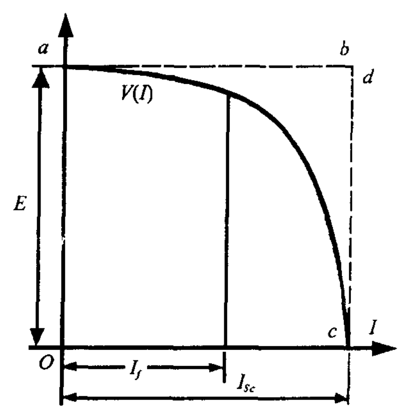

Fig. 1. 3

In other words, the voltage drop V_S across the source resistance rises in proportion to the current. This goes on until a certain limit is reached. Then as the current keeps rising, the proportionality between its value and the voltage drop across the source is upset, and the external characteristic ceases to be linear. This decrease in voltage may be caused by a reduction in the source voltage, by an increase in the internal resistance, or both.

The power delivered by a source is given by the equality

$$P_S = EI \quad (1.2)$$

where P_S is the power of the source.

It seems relevant at this point to dispel a common misconception about power. Thus one may hear that power is generated, delivered, consumed, transmitted, lost, etc. In point of fact, however, it is energy that can be generated, delivered, consumed, transmitted or lost. Power is just the rate of energy input or conversion, that is, the quantity of energy generated, delivered, transmitted, etc. per unit time. So, it would be more correct to use the term energy instead of power in the above context. Yet, we would rather fall in with the tradition.

The load resistance R (Fig. 1. 2(b)), as a generalized circuit element, gives an idea about the consumption of energy, that is, the conversion of electric energy into heat, and is defined as

$$P = RI^2 \tag{1.3}$$

In the general case, the load resistance depends solely on the current through the load, which fact is symbolized by the function $R(I)$.

By Ohm's law, the voltage across a resistance is

$$V = RI \tag{1.4}$$

In circuit analysis, use is often made of the reciprocal of the resistance, termed the conductance, which is defined as

$$g = 1/R$$

In practical problems, one often specifies the voltage across a resistance as a function of current, $V(I)$, or the inverse relation $I(V)$, rather than the resistance as a function of current, $R(I)$. The relations of the form $V(I)$ or $I(V)$ have come to be known as volt-ampere characteristics.

Fig. 1. 4 shows volt-ampere curves for a metal-filament lamp, $V_1(I)$, and for a carbon-filament lamp $V_2(I)$. As is seen, the relation between the voltage and the current in each lamp is other than linear. The resistance of the metal-filament lamp increases, and that of the carbon-filament lamp decreases with increase of current.

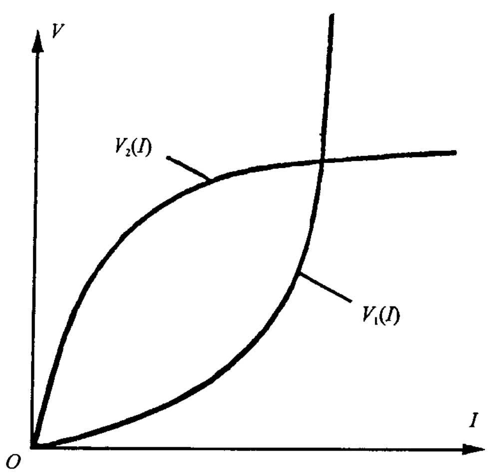

Fig. 1. 4

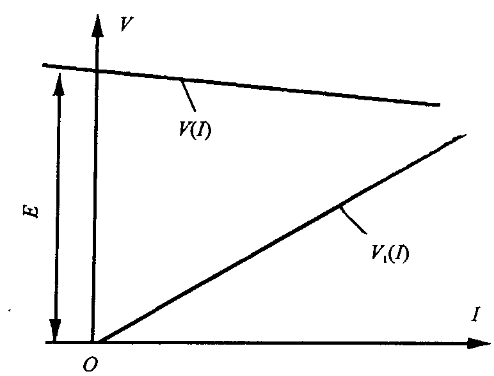

Fig. 1. 5

Electric circuits containing components with non-linear characteristic are called non-linear.

If the e. m. f and internal resistances of sources and associated load resistances are assumed to be independent of the current and voltage, respectively, the external characteristic $V(I)$ of the sources and the volt-ampere characteristic $V_1(I)$ of the loads will be linear (Fig. 1. 5).

Electric circuits containing only elements with linear characteristic are called linear.

Most practical circuits may be classed as linear. Therefore, a study into the properties and analysis of linear circuits is of both theoretical and applied interest.

1. 2 Specialized English Words

circuit components 电路元件
circuit parameters 电路参数
electric circuit 电路
electrical device 电气设备
electric energy 电能
energy source 电源
primary cell 原生电池
secondary cell 再生电池
energy converter 电能转换器
conductor 导体
generator 发电机
heating appliance 电热器
direct-current(D. C.) circuit 直流电路
magnetic and electric field 电磁场
time-invariant 时不变的
self-(or mutual-) induction 自(互)感
displacement current 位移电流
the dielectric 电介质
storage battery 蓄电池
wire 导线
e. m. f. =electromotive force 电动势
unidirectional current 单方向性电流
circuit diagram 电路图
load characteristic 负载特性
terminal voltage 端电压
external characteristic 外特性
load resistance 负载特性
voltage drop 电压降
conductance 电导
volt-ampere characteristics 伏安特性
metal-filament lamp 金属丝灯泡
carbon-filament lamp 碳丝灯泡
non-linear characteristics 非线性特性

1. 3 Notes

1. 3. 1 When electric energy is generated, transmitted and converted under conditions such that the currents and voltages involved remain constant with time, one usually speaks of direct-current(D. C.) circuits. 这是一个主从复合句，When…time，是一个由 When 引导的时间状语从句，one…circuits. 是整个句子的主句。只是在从句中又包含了一个由 such that 引导的结果状语从句，该从句的主语是 the currents and voltages，involved 是它的后置定语，意为“牵涉到的，涉及到的”，remain 是系动词作谓语，constant 是形容词作表语，结果状语从句是系表结构。因此，整句翻译成“当电能在产生、传输和变换时，若电路中相关的电

流和电压不随时间而变化，我们便称其为直流电路"。可以看出，结果状语从句...conditions such that...并没有直接译出，否则译成"在所涉及到的电路和电压随时间保留常数这样一种情况下……"就不是很合汉语的习惯，因此我们采用了翻译方法中的"转换法"，将结果状语从句转译成条件状语从句，这样中文的译文更地道。

1.3.2 The terminals of the source and load are interconnected by conductors (generally but not always wires). 中的 generally but not always wires = generally wires, but not always wires，意为"通常这种导体是导线，但少数情况下也有例外"。

1.3.3 This simple circuit made up of a source, a load and two wires is seldom, if ever, met with in practice. = This simple circuit made up of a source, a load and two wires is seldom met with in practice, if it is ever met with in practice sometimes. 意为"这种由一个电源、一个负载和两根导线组成的简单电路即使在实践中有时能遇到，也是很少见的"。

1.3.4 Whatever its origin (thermal, contact, etc.), the source e. m. f. E (Fig. 1.2(a)) is numerically equal to the potential difference between terminals 1 and 2 with the external circuit open, ... 中的 between terminals 1 and 2 说明 difference，而 with the external circuit open 则修饰 terminals 1 and 2，因此此句译为"无论电动势 E 的原动力是什么(即不论是热的，摩擦的还是其他什么形式)，其大小就等于 1、2 两端之间的开路电压"。

1.4 Translation

电路元件与参数

电路(或网络)是各电器装置的实物联接体。电路的作用是分配电能和转换能量形式。因此，电路的基本元件是电源、能量转换器以及它们之间的连接导线。

电源(如原生电池、再生电池和发电机等)将化学能、热能或其他形式的能量转换成电能。能量转换器(也称作负载，比如灯泡、取暖器及电机等)将电能转换成光、热和机械等能量。

电路的工作情况可以用电势(或电压)和电流来描述。当电能在产生、传输和变换时，若电路中相关的电流和电压不随时间而变化，我们便称其为直流电路。

对于时不变的电流和电压，与电气设备相联系的电场和磁场也是时不变的。这也就是为什么在直流电路中没有自感和互感电动势及在导体的周围电介质中也没有位移电流的原因。

图 1.1 用简化的方式表示以蓄电池作电源，灯泡作负载的一个假想电路。电源和负载端有导体(通常是导线，但少数情况下也有例外)连接，如图所示，电源、负载和导体形成一个闭合回路。电动势产生一个绕该闭合回路的连续单向的电流。

这种由一个电源、一个负载和两根导线组成的简单电路，在实际中即使能碰见也是很少的。实际电路可能包括许多按不同方式连接的电源和负载。

为简化对实际电路的分析，通常将它画成用符号表示的电路图，这种电路图实际上是虚构的，或更确切地说是实际电路或网络的理想模型。这种电路由相互连接的称为电路元件或电路参数符号组成。为了表示一直流电路，至少得有两种元件，这就是电动势为 E、内阻为

R_S 的电源和负载电阻(包括连接导体的电阻)R(见图 1.2)。

无论电动势 E 的原动力是什么(即不论是热、摩擦还是其他形式产生的),电源电动势 E(见图 1.2(a))在数值上等于 1、2 两端之间的开路电压,即当电源中无电流通过时:

$$E = \varphi_1 - \varphi_2 = V_{12} \tag{1.1}$$

电源电动势的方向是从低电位点指向高电位点,在电路图中用箭头表示。

当一负载与电源相连(此时电路称为已载荷)形成闭合回路,在此回路中便有电流。由于电源内部的压降 V_S(也即内阻 R_S 上的压降)

$$V_S = R_S I$$

这时电源 1、2 两端之间(也称端电压)便不等于它的电动势。

图 1.3 表示了一个带负载后电源的典型的所谓外特性 $V_{12}=\varphi_1-\varphi_2=V(I)$(也称为电源的负载特性)。从图中可看出,当电流从零增大到 $I\approx I_1$ 时,电源端电压将线性下降

$$V_{12} = V = E - V_S = E - R_S I$$

换句话说,电源内阻两端的压降 V_S 与电流成正比。该过程一直持续到电流达到某一临界值为止。然后,随着电流的继续增大,其与电源端电压之比值便变了,外特性也不再为线性的。电压的这种下降也许是由于电源电压的下降,也许是由于内阻的增大,或者两者兼而有之。

电源提供的功率由下式确定

$$P_S = EI \tag{1.2}$$

式中,P_S 为电源功率。

在此看来应该消除关于功率的一种通常错误的概念,比如人们可能听说过关于功率的产生、提供、消耗、传输、损耗等等的说法。然而,事实上,正是能量才有产生、提供、消耗、传输和损耗的说法,功率仅是能量的输入或转换的比率,即单位时间内产生、提供和传输等的能量值。因此,在上述内容中用“能量”这个术语而不用“功率”会更准确些,不过人们习惯了传统的说法。

作为一种抽象化的电路元件,负载电阻 R(见图 1.2(b))形成了一个消耗能量的概念,即将电能转换成热量,因此定义为

$$P = RI^2 \tag{1.3}$$

通常,负载电阻仅取决于通过负载的电流,这一点可用 $R(I)$ 的函数符号来表示。

由欧姆定律可知,电阻两端的电压为

$$V = RI \tag{1.4}$$

在电路分析中,常常使用电阻的倒数,称之为电导,其定义为

$$g = 1/R$$

在实际问题中,人们并不常常将电阻表示为电流的函数 $R(I)$,而将电阻两端电压表示为电流的函数 $V(I)$,或其反函数 $I(V)$。函数 $V(I)$ 或 $I(V)$ 的关系已成为人所共知的伏-安特性。

图 1.4 中的曲线 $V_1(I)$ 和 $V_2(I)$ 分别表示一金属丝灯泡和碳丝灯泡的伏-安特性曲线。如图所示每个灯泡的电流和电压之间的关系并不是线性的。随着电流的增加,金属丝灯泡的电阻是增加的,而碳丝灯泡的电阻是减小的。

含有非线性元件的电路称为非线性电路。

假如电源的电动势和内阻与其联接的负载电阻被认为均不随电流和电压变化而变化，那么电源的外特性 $V(I)$和负载的伏-安特性 $V_1(I)$将为线性的(见图 1.5)。

仅含线性元件的电路称为线性电路。

大多数实际电路可归类为线性电路。因此，对线性电路性能和线性电路分析的研究就具有理论和实践的双重意义。

Unit 2

2. 1 Text

Ideal Sources Series and Parallel Equivalent Circuits

Consider an elementary circuit containing a single source of e. m. f. E and of internal resistance R_S, and a single load R (Fig. 2. 1). The resistance of the conductors of this type of circuit may be neglected. In the external portion of the circuit, that is, in the load R, the current is assumed to flow from the junction a (which is at a higher potential such that $\varphi_a=\varphi_1$) to the junction b(which is at a lower potential such that $\varphi_b=\varphi_2$). The direction of current flow may be shown either by a hollow arrowhead or by supplying the current symbol with a double subscript whose first digit identifies the junction at a higher potential and the second the junction at a lower potential. Thus for the circuit of Fig. 2. 1, the current $I=I_{ab}$.

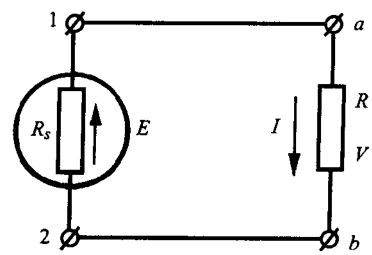

Fig. 2. 1

We shall show that the circuit of Fig. 2. 1 containing a source of known e. m. f. E and source resistance R_S may be represented by two types of equivalent circuits.

As already stated, the terminal voltage of a loaded source is lower than the source e. m. f. by an amount equal to the voltage drop across the source resistance:

$$V=\varphi_1-\varphi_2=E-V_S=E-R_SI \tag{2.1}$$

On the other hand, the voltage across the load resistance R is

$$V=\varphi_a-\varphi_b=RI \tag{2.2}$$

Since $\varphi_1=\varphi_a$ and $\varphi_2=\varphi_b$, from Eqs. (2. 1) and (2. 2) it follows that $E-R_SI=RI$, or

$$E=R_SI+RI \tag{2.3}$$

and

$$I=E/(R_S+R)$$

From the last equation we conclude that the current through the source is controlled by both the load resistance and the source resistance. Therefore, in an equivalent circuit diagram the source resistance R_S may be shown connected in series with the load resistance R. This configuration may be called the series equivalent circuit (usually known as the Thevenin equivalent source).

Depending on the relative magnitude of the voltages across R_S and R, we can develop two modifications of the series equivalent circuit. In the equivalent circuit of Fig. 2. 2(a), V is controlled by the load current and is decided by the difference between the source e. m. f. E and the voltage drop V_S. If $R_S\ll R$ and, for the same current, $V_S\ll V$ (that is, if the