普通高等教育"十五"国家级规划教材

自动控制英语

English for Automatic Control

《自动控制英语》教材编写组 编

高等教育出版社
Higher Education Press

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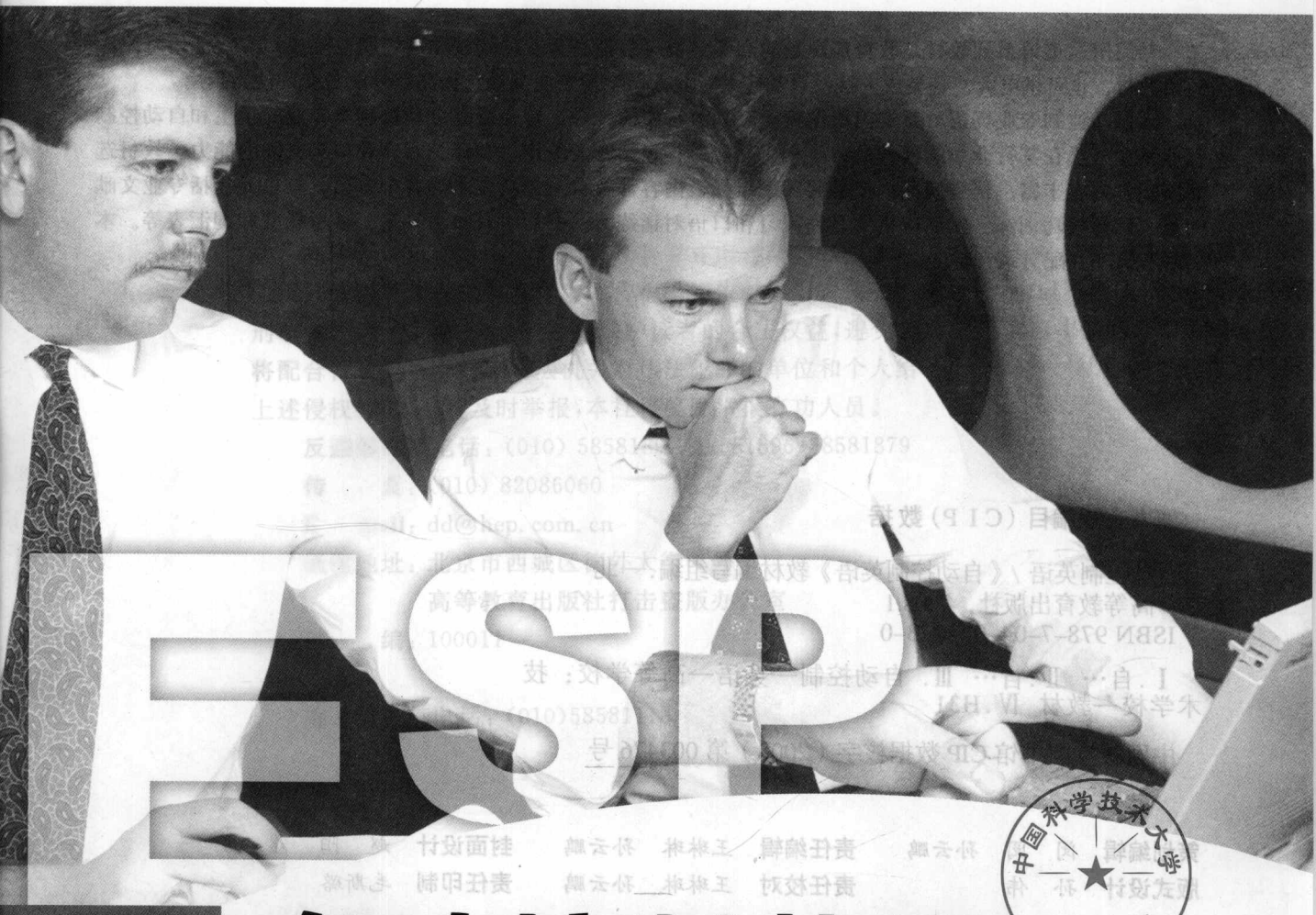

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内容提要

专门用途英语系列教材是教育部规划的高等学校（包括高等专科院校和高等职业院校）专业英语阶段的英语教材，也可供电大、各类成人院校以及广大专业人员学习专业英语、提高涉外业务交际能力使用。

《自动控制专业英语》系专门用途英语系列教材中的一种，旨在提高自动控制类专业的学生和自动控制行业从业人员在其行业中的涉外业务英语交际能力，包括专业阅读、翻译、写作和口头交际的能力。教材选题新颖、内容丰富、语言规范。全书共10个单元，内容涉及自动控制技术的各个方面。每单元包括专业文献阅读、翻译技巧训练、实际应用文写作练习和口语对话练习。书后附有参考答案、参考译文和词汇表等。本书附有MP3并配有录音带。

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前　言

专门用途英语系列教材是教育部规划的高等院校专业英语阶段的英语教材。本系列教材从高等技术应用型人才培养的总体目标出发，结合学生毕业后的工作实际，力求向学生提供其未来工作岗位所需要的专业英语知识技能，培养学生使用涉外业务英语的能力。

本系列教材主要供高等院校（包括高等专科院校和高等职业院校）专业英语教学使用，也可供电大、各类成人院校及广大专业人员学习专业英语、提高涉外业务交际能力使用。

《自动控制英语》系专门用途英语系列教材中的一种，旨在提高自动控制类专业的学生和自动控制行业从业人员在其行业中涉外业务英语的交际能力，包括专业阅读、翻译、写作和口头交际的能力。

《自动控制英语》共10个单元，每单元分为4个部分：

1．第一部分为“阅读理解”（Reading Comprehension），旨在培养学生阅读自动控制类专业英语的能力。本部由A、B两篇文章组成，内容包括：控制系统的发展过程、控制系统的未来前景、自动控制系统在电力、交通、通讯等各方面的应用、自动控制系统的先进技术及设备等。

2．第二部分为“翻译技巧”(Translation Skills)，旨在帮助学生掌握基本的翻译技巧，以提高英译汉的翻译能力。

3．第三部分为“实用写作”(Practical Writing)，旨在培养学生参照范例用英语拟写和翻译商业信件、涉外合同、产品广告等应用文的能力。

4．第四部分为“交际会话”(Communicative Speaking)，旨在培养学生的口语交际能力。本部分的内容涉及应聘面试、接待外宾、参观访问、协议洽谈等。

本书内容新颖，知识面广，突出强调了自动控制技术在实际中的应用。本书语言规范，练习的设计具有实用性和针对性。书后附有练习答案和参考译文，便于学生使用。

沈阳工程学院刘然教授担任本书的主编，并编写了全书的第二、第三和第四部分，以及词汇表。副主编于轶编写了第3和第9单元的第一部分；副主编郭南对全书的译文进行了全面的改稿和润色，并配置了每单元的插图。金品卓编写第1单元的第一部分，刘岩编写第2单元的第一部分，曹艳春编写第4单元的第一部分，冯威编写第6和第8单元的第一部分，冯冬惠编写第7和第10单元的第一部分，李岱菊编写第5单元的第一部分。

由于编者水平有限，有疏忽和不妥之处，恳请广大读者批评指正。

编　者

2007年12月

Contents

1 Control System

UNIT

Part I Reading Comprehension

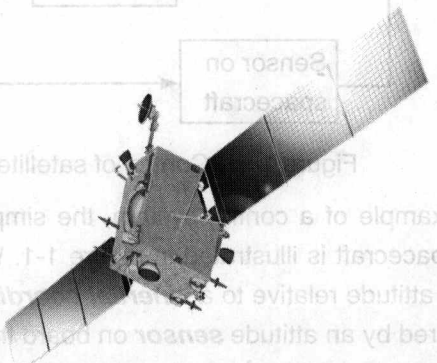
■ Reading A

Control System

The desire to control the forces of nature has been with man since early civilizations. Although many examples of control systems existed in early times, it was not until the mid-eighteenth century that several steam-operated control devices appeared[1]. This was the time of the steam engine, and perhaps the most ***noteworthy*** invention was the speed-control flyball governor invented by James Watt. 值得关注的

Around the beginning of the twentieth century much of the work in control systems was being done in the power generation and the chemical processing industry. Also by this time, concept of the ***autopilot*** for airplanes had been fairly well developed. 自动驾驶仪

The period beginning about twenty-five years before World War Two saw rapid advances in electronics and especially in circuit theory, aided by the now classical work of Nyquist in the area of stability theory[2]. The requirements of sophisticated weapon systems, submarines, aircrafts and the like gave new ***impetus*** to the work in control systems before and after the war. The ***advent*** of the ***analog*** computer coupled with advances in electronics saw the beginning of the establishment of control systems as a science. By the mid-fifties, the progress in digital computers had given the engineers a new tool that greatly enhanced their capability to study large and complex systems. The availability of computers also opened the era of ***data-logging***, computer control, and the state space or modern method of analysis. 推动；出现 模拟 数据记录



The ***sputnik*** began the space race and large governmental expenditures in the space as well as military effort. During this time, circuits became miniaturized and large sophisticated systems could be put together very compactly, which brought a computational and control advantage coupled with systems of small physical dimensions. We are now capable of designing and flying minicomputers and landing men on the moon[3]. The post sputnik age saw much effort in system ***optimization*** and adaptive systems.

前苏联人造地球卫星

优化

Finally, the ***refinement*** of the chip and related computer development has created an explosion in computational capability and computer-controlled devices. This has led to many innovative methods in manufacturing methods, such as computer-aided design and manufacturing, and the possibility of ***unprecedented*** increases in industrial productivity via the use of computer-controlled machinery, ***manipulators*** and ***robotics***.

精致

空前的

操作装置；机器人技术

Today control systems, a science with art, are still playing an important role. Much mathematical sophistication has been achieved with considerable interest in ***optimal*** control systems. The modern approach, having been established as a science, is being applied not only to the traditional control systems, but to newer problems like urban analysis, ***econometrics***, transportation, ***biomedical*** problems, energy analysis, and a host of similar problems that affect modern man.

最佳的

经济计量学

生物医学的

Because control systems occur so frequently in our lives, their study is quite important. Generally, a control system is composed of several ***subsystems*** connected in such a way as to yield the proper cause-effect relationship[4]. Since the various subsystems can be electrical, mechanical, ***pneumatic***, biological, etc., the complete description of the entire system requires the understanding of fundamental relationships in many different disciplines. Fortunately, the similarity in the dynamic behavior of different physical systems makes this task easier and more interesting.

子系统

气动的

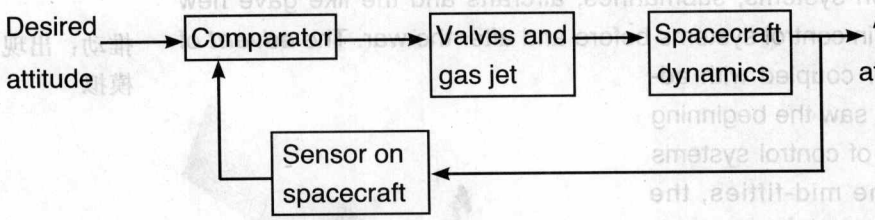


Figure 1-1 Control of satellite attitude

As an example of a control system, the simplified version of the attitude control of a spacecraft is illustrated in Figure 1-1. We wish the satellite to have some specific attitude relative to an ***inertial coordinate*** system. The actual attitude is measured by an attitude ***sensor*** on board the satellite. If the desired and actual attitudes are not the same, the ***comparator*** would send a signal to the

惯性的；协调的

传感器

比较器

valves which open and cause gas jet firings. These jet firings give the necessary ***corrective*** signal to the satellite dynamics so that the satellite can be under control. A control system represented this way is said to be represented by block diagrams[5]. Such a representation is helpful in the ***partitioning*** of a large system into subsystems and therefore, we can study one subsystem at a time.

修正的

分割

If we have many inputs and outputs that are monitored and controlled, the block diagram appears as illustrated in Figure 1-2. Systems where several variables are monitored and controlled are called ***multivariable*** systems[6]. Examples of multivariable systems are found in chemical processing, guidance and control of vehicles, the national economy, urban housing growth patterns, the postal service, and a host of other social and urban problems.

多变量的

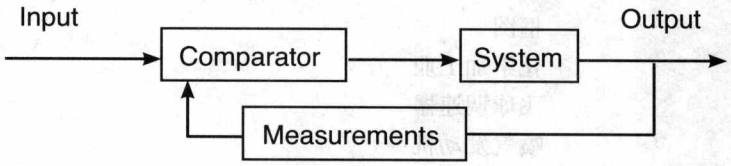


Figure 1-2 Representation of a multivariable system

NEW WORDS AND USEFUL EXPRESSIONS

advent /ˈædvənt/ *n.*	出现
analog /ˈænəlɒg/ *n.*	模拟
autopilot /ˈɔːtəpaɪlət/ *n.*	自动驾驶仪
biomedical /ˌbaɪəʊˈmedɪkəl/ *a.*	生物医学的
comparator /ˈkɒmpəreɪtə/ *n.*	比较器
coordinate /kəʊˈɔːdɪneɪt/ *a.*	协调的
corrective /kəˈrektɪv/ *a.*	修正的
data-logging /ˈdeɪtə lɒgɪŋ/ *n.*	数据记录
econometrics /ɪˌkɒnəˈmetrɪks/ *n.*	经济计量学
impetus /ˈɪmpɪtəs/ *n.*	推动
inertial /ɪˈnɜːʃəl/ *a.*	惯性的
manipulator /məˈnɪpjʊleɪtə/ *n.*	操作装置
multivariable /ˈmʌltɪveərɪəbl/ *a.*	多变量的
noteworthy /ˈnəʊtwɜːðɪ/ *a.*	值得关注的
optimal /ˈɒptɪməl/ *a.*	最佳的
optimization /ˌɒptɪmaɪˈzeɪʃən/ *n.*	优化
partitioning /pɑːˈtɪʃənɪŋ/ *n.*	分割
pneumatic /njuːˈmætɪk/ *a.*	气动的
refinement /rɪˈfaɪnmənt/ *n.*	精致

robotics /rəʊˈbɒtɪks/ *n.*	机器人技术
sensor /ˈsensə/ *n.*	传感器
sputnik /ˈspʊtnɪk/ *n.*	前苏联人造地球卫星
subsystem /ˈsʌbˌsɪstɪm/ *n.*	子系统
unprecedented /ʌnˈpresɪdəntɪd/ *a.*	空前的
a host of	大量的
analog computer	模拟计算机
apply to	将…应用于
at a time	每次
be capable of doing	能够做
be composed of	由…组成
be coupled with	结合
block diagram	框图
chemical processing industry	化学加工业
flyball governor	飞球调速器
gas jet	喷气发动机
national economy	国民经济
on board	在船上，在飞机上
power generation	电力生产
stability theory	稳定理论
state space	状态空间
steam engine	蒸汽机

NOTES

1 it was not until...that....此句型意为“直到…才”。例如：It was not until yesterday that I noticed it.（直到昨天我才注意到这件事。）此句可翻译为：虽然在早期进行过多种控制系统的尝试，但直到18世纪中叶才出现一些蒸汽驱动控制装置。

2 此句中 see 的意思为“经历；目睹”，一般用时间作它的主语。例如：The 19th century saw many changes.（许多变革发生于19世纪。）此句可翻译为：大约在二战前25年，借助于稳定理论领域中奈奎斯特的古典理论，电子工业特别是电路理论的发展取得飞速进展。

3 此句中 be capable of 的意思为“能够”，指人时常表示“有…的能力；有…的倾向”；指物时常表示“易于；有…的余地；可以…”。例如：He is capable of judging art.（他具有鉴赏艺术的能力。）

4 connected...为后置定语，修饰 subsystems; such...as to do...表示到达某种程度。例如：We are not such fools as to believe him.（我们不会那么蠢，竟会相信他。）此句可翻译为：总的说来，一个控制系统是由若干存在一定因果关系的子系统组成的。

5 此句中有两个 represented，但意义不同。represented this way 为后置定语，修饰 system，在此，represent 意为“表现”；而 to be represented by block diagrams 为主语补足语，represent 意为“描绘”。此句可翻译为：下面用框图描述一个用这种方法所表现的控制系统。

6 在此句中，where several variables are monitored and controlled 为定语从句，修饰 systems。此句可翻译为：检测和控制若干变量的系统，称作多变量系统。

Exercise 1

Translate the following phrases into Chinese.

1) control system _____
2) the area of stability theory _____
3) sophisticated weapon system _____
4) open the era of data-logging _____
5) unprecedented increases _____
6) multivariable systems _____
7) cause-effect relationship _____
8) biomedical problem _____
9) industrial productivity _____
10) circuit theory _____

Exercise 2

Translate the following phrases into English.

1) 速度控制飞球调速器 _____
2) 飞机的自动驾驶仪 _____
3) 现代分析方法 _____
4) 数字计算机 _____
5) 自适应系统 _____
6) 许多革新的方法 _____
7) 电脑辅助设计 _____
8) 国民经济 _____
9) 发出修正信号 _____
10) 卫星上的传感器 _____

Exercise 3

Fill in the blanks with the proper words given below, changing the form where necessary.

sophisticated	machinery	electrical	electronics	energy
operate	chemical	monitor	simplify	generate

1) The workers have been told to improve their _____ level.
2) When coal burns, it _____ heat.
3) The _____ in the factory consists of several different kinds of machines.
4) We have been _____the enemy's radio broadcasts to try to find out their secret plans.
5) The system isn't working because of a(n) _____ fault.
6) The English in this specification has been _____ to make it easier to understand.
7) The _____ aboard the new aircraft are very sophisticated.
8) A(n) _____ change takes place in any substance when it burns.
9) The latest and most _____ technology has been applied to the new machines.
10) Each year Americans consume a high percentage of the world's _____.

■ Reading B

Design, Modeling and Analysis of Control System

Prior to the building of a piece of hardware, a system must be designed, modeled, and analyzed. Actually the analysis is an important and essential feature of the design process. In general, when we design a control system, we do so ***conceptually***. Then we generate a mathematical model which is analyzed. 概念地
The results of this analysis are compared to the performance specifications that are desired for the proposed system. The accuracy of the results depends upon the quality of the original model of the proposed design. For example, the Sun Tracker is a conceptual design. The objective then may be considered to be the prediction, prior to construction, of the dynamic behavior that a physical system exhibits, i.e. its natural motion when disturbed from an ***equilibrium*** position and 平衡
its response when excited by external ***stimuli***. Specifically we are concerned 激励
with the speed of response or ***transient*** response, the accuracy or steady state 瞬时的
response, and the stability. By stability we mean that the output remains within certain reasonable limiting values. The relative weight given to any special requirement is dependent upon the specific application[1]. For example, the air conditioning of the interior of a building may be maintained to ±1℃ and satisfy

the ***occupants***. However, the temperature control in certain ***cryogenic*** systems requires that the temperature be controlled to within a fraction of a degree. The requirements of speed, accuracy, and stability are quite often contradictory and some compromises must be made. For example, increasing the accuracy generally makes for poor transient response. If the ***damping*** is decreased, the system ***oscillations*** increase and it may take a long time to reach some steady state value.

居住者；低温学的

阻尼
摆动

It is important to remember that all real control systems are ***nonlinear***; however, many can be approximated within a useful though limited range as linear systems[2]. Generally, this is an acceptable first ***approximation***. A very important benefit to be derived by assuming ***linearity*** is that ***superposition theorem*** applies[3]. If we obtain the response due to two different inputs, the response due to the combined input is equal to the sum of the individual response[4]. Another benefit is that operational mathematics can be used in the analysis of linear systems. The operational method allows us to transform ordinary ***differential equations*** into ***algebraic*** equations, which are much simpler to handle[5].

非线性的

近似值
线形；重叠
定理

微分的；方程；代数的

Traditionally, control systems were represented by higher-order linear differential equations and the techniques of operational mathematics were employed to study these equations. Such an approach is referred to as the classical method and is particularly useful for analyzing systems characterized by a single input and a single output. As systems began to become more complex, it became increasingly necessary to use a digital computer. The work on a computer can be ***advantageously*** carried out if the system under consideration is represented by a set of first-order differential equations and the analysis is carried out via ***matrix*** theory. This is in essence what is referred to as the state space or state ***variable*** approach. This method, although applicable to single input-output systems, finds important applications in the multivariable system[6]. Another very attractive benefit is that it enables the control system engineers to study variables inside a system.

方便地

矩阵
变量

We must note that although the easier route is to initially begin with the classical viewpoint, it is the state approach that is more natural for the more complex and interesting problems. At this level, a thorough study should necessarily include both viewpoints.

Regardless of the approach used in the design and analysis of a control system, we must at least follow the following steps:

1. ***Postulate*** a control system and state the system specifications to be satisfied.

设定

2. Generate a functional block diagram and obtain a mathematical representation of the system.

3. Analyze the system using any of the analytical or ***graphical*** methods applicable to the problem. 绘画的

4. Check the performance (speed, accuracy, stability, or other criterion) to see if the specifications are met.

5. Finally, ***optimize*** the system parameters so that the first step is satisfied. 使最优化

Whatever the physical system or specific arrangement it is, we shall see that there are only a few basic concepts and analytical tools that are ***pivotal*** to the prediction of system behavior. The fundamental concepts that are learned here and applied to a few examples have therefore a much wider range of applicability[7]. The real range will only be clear when you start working with the ideas to be developed here. 关键的

NEW WORDS AND USEFUL EXPRESSIONS

advantageously /ˌædvənˈteɪdʒəslɪ/ *ad.*	方便地
algebraic /ˌældʒɪˈbreɪɪk/ *a.*	代数的
approximation /əˌprɒksɪˈmeɪʃən/ *n.*	近似值
conceptually /kənˈseptʃʊəlɪ/ *ad.*	概念地
cryogenic /ˌkraɪəʊˈdʒenɪk/ *a.*	低温学的
damping /ˈdæmpɪŋ/ *n.*	阻尼
differential /ˌdɪfəˈrenʃəl/ *a.*	微分的
equation /ɪˈkweɪʃən/ *n.*	方程
equilibrium /ˌiːkwɪˈlɪbrɪəm/ *n.*	平衡
graphical /ˈgræfɪkəl/ *a.*	绘画的
linearity /ˌlɪnɪˈærɪtɪ/ *n.*	线形
matrix /ˈmeɪtrɪks/ *n.*	矩阵
nonlinear /nʌŋˈlɪnɪə/ *a.*	非线性的
occupant /ˈɒkjʊpənt/ *n.*	居住者
optimize /ˈɒptɪmaɪz/ *v.*	使最优化
oscillation /ˌɒsɪˈleɪʃən/ *n.*	摆动
pivotal /ˈpɪvətl/ *a.*	关键的
postulate /ˈpɒstjʊleɪt/ *v.*	设定
stimuli /ˈstɪmjʊlaɪ/ *n.*	激励
superposition /ˌsjuːpəpəˈzɪʃən/ *n.*	重叠
theorem /ˈθɪərəm/ *n.*	定理
transient /ˈtrænzɪənt/ *a.*	瞬时的
variable /ˈveərɪəbl/ *n.*	变量
a fraction of	一小部分
a range of	一系列，一批，一套

be dependent upon	依靠；取决于
be equal to	等于
be referred to as	被称为
carry out	完成，实现，贯彻，执行
differential equation	微分方程
due to	由于
first-order differential equations	一阶的微分方程
higher-order	序列高阶
in essence	实质上
linear system	线性系统
make for	有助于，倾向于
mathematical representation	数学表达式
multivariable system	多变量系统
operational mathematics	算子数学
prior to	在…之前
regardless of	不管，不顾
relative weight	稳定裕量
state approach	状态空间方法
superposition theorem	叠加定理

NOTES

1 此句中 given to any special requirement 为后置定语，修饰句子主语 the relative weight。全句可翻译为：就任何特殊要求提出的稳定裕量取决于其具体应用要求。

2 此句中 within the range 意为“在…范围内”；though 表示转折，含义相当于 but 。可翻译为：… 但有许多系统可以在一个有限但却有用的范围内接近于线性系统。

3 此句中 to be derived by assuming linearity 为后置定语，修饰句子主语 benefit；that superposition theorem applies 为表语从句。全句可翻译为：由假定线性得出的一个很重要的优点是可应用叠加定理。

4 此句中 due to two different inputs 为后置定语，修饰条件从句宾语 response；due to the combined input 也是后置定语，修饰主句主语 response。全句可翻译为：如果是由两个不同的输入得到一种响应，则该响应相等于单个响应之合。

5 此句中 which are much simpler to handle 为非限制性定语从句，修饰 algebraic equations。由于定语从句较短，可按限制性定语从句的规则来翻译。全句可翻译为：这种运算方法可以使我们将普通的微分方程转为更容易处理的代数方程。

6 此句中 although applicable to single input-output systems 可看做插入语，表示转折。全句可翻译为：这种方法不仅适用于单个输入— 输出系统，亦可在多变量系统中起重要作用。

7 在 that 引导的定语从句中，are learned 和 applied to 为并列谓语。全句可翻译为：因此，这里研究的和在几个事例中使用的基本概念有很广泛的应用范围。

Exercise 1

Match the following English phrases in Column A with their Chinese equivalents in Column B.

1) generate a mathematical model	A) 保持在一个合理的限定数值内
2) a conceptual design	B) 达到一定的稳定状态值
3) remain within certain reasonable limiting values	C) 得出数学模型
4) reach some steady state value	D) 等于单个响应之合
5) equal to the sum of the individual response	E) 一个概念性的设计
6) the analysis of linear systems	F) 一组一阶的微分方程
7) state variable approach	G) 古典的观点
8) classical viewpoint	H) 几个基本概念
9) a few basic concepts	I) 状态变量方法
10) a set of first-order differential equations	J) 线性系统的分析

Exercise 2

Translate the following sentences into Chinese.

1) Prior to the building of a piece of hardware, a system must be designed, modeled, and analyzed.

2) However, the temperature control in certain cryogenic systems requires that the temperature be controlled to within a fraction of a degree.

3) For example, increasing the accuracy generally makes for poor transient response.

4) Regardless of the approach used in the design and analysis of a control system, we must at least follow the following steps.

5) Such an approach is referred to as the classical method and is particularly useful for analyzing systems characterized by a single input and a single output.