



高等学校教材  
科技英语系列教程

Technology

Science

English

Control Engineering

主编 陈蓓

# 控制工程科技英语

English of Science and Technology for Control Engineering

西北工业大学出版社

高等学校教材

# 控制工程科技英语

## English of Science and Technology for Control Engineering

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**【内容简介】** 本书旨在使学生能够熟悉并掌握控制工程领域方面的基本英语词汇,并提高与此相关专业英文文献的阅读能力。其主要内容包括科技英语语法、科技英文写作、经典控制理论、现代控制理论等。

本书选材丰富多样,涉及科技英语和控制工程各方面的内容,专业词汇涵盖面广,选取的文章具有代表性、新颖性、实用性和参考性,从而使教师在选择教学内容方面有极大的灵活性和应用性。

本书适合于自动控制、电子信息、通信、计算机网络、信息系统等相关专业的本、专科生作为专业英语课程的教材,并有助于自动控制领域的技术人员提高阅读英文专业文献的能力。

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# Preface

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In line with globalization and the rapid advances in information and communications technology (ICT), knowledge is available in greater volume and speed than ever before. Learners should be taught the various ways of accessing this information and to use the information to advance their knowledge in various fields. This syllabus is a step in that direction. Students opting for this course will also be required to study English as outlined in the general English syllabus. This general English syllabus is developed in line with the way English is used in society in everyday life, i. e. when interacting with people (the Interpersonal); when accessing information (the Informational), and when enjoying books (the Aesthetic). The English for Control Engineering syllabus lays the foundation in the use of English in the fields of science and technology not only for the present but also for further studies at English for Science and Technology Syllabus.

This program does not aim to teach the subject matter of science. Rather, it is designed to help students develop an ability to grasp basic concepts and ideas in science and to understand methods of scientific thought and enquiry in English common to all kinds of scientific and technical discourse. The knowledge gained will not only enhance personal learning but also enable learners to think critically of issues in science and technology. Science and Technology embraces a wide area of knowledge. For the purposes of this syllabus, areas covered include general science, classical control theory, modern control theory and various technologies. As such, the syllabus uses topics and themes that relate directly to all of the control science and technology curricula. With this syllabus, learners will be introduced to the main control concepts and ideas of science in English. Topics or themes for study are founded upon the basic concepts, ideas and methods of scientific thought and enquiry that are common to the many branches of science and technology such as describing, classifying, accounting for observed results, concluding, and so on.

Notions and ideas such as time, space, place, size, similarities, differences and relationships are also incorporated. Topics and themes act as vehicles for instruction and incorporate basic concepts and ideas. These topics and themes are kept as simple as possible, referring wherever possible, to everyday examples. The use of authentic materials is greatly encouraged so that students become familiar with the register of science. Where texts need to be adapted and modified to suit student ability, then care that must be taken to ensure factual accuracy of content is not compromised. The communicative methodology is recommended for teaching this syllabus. Teachers are encouraged to teach topics using the double language skills in an integrated manner. Learners are also encouraged to use the language actively and to participate actively in the learning process. The use of English for science and technology supports the aims and objectives of the National Philosophy of Education and contributes towards the optimization of the intellectual, emotional, spiritual and physical potential of the learners. The curriculum also recognizes that learners learn in different styles and ways. They possess their own unique strengths and weaknesses and wherever possible individual needs should be taken into account in teaching.

In this book Bei CHEN is editor in chief who edits from Unit 1 to Unit 12 except Unit 5. Wenlun CAO edits from Unit 13 to Unit 17, and Unit 5 is edited by Lan CHEN. The last three units are edited by Xiaojun XING together with Mei WU. I gratefully acknowledge the assistance of the many who have contributed bits of information, pictures and documents. I am especially indebted to the editors and proofreaders of NWPUP. Errors and unintentional omissions, however, are my own.

Editor  
August, 2007

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# Part I Introduction of EST

## Unit 1 English for Science and Technology

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In line with learners should be taught the various ways of accessing the information and to use the information to advance their knowledge in various fields. This syllabus is a step in that direction. English for Science and Technology is introduced as an elective at the upper college level. Students opting for this elective will also be required to study English as outlined in the general English syllabus. This general English syllabus is developed in line with the way that English is used in society in everyday life, i. e. when interacting with people (the Interpersonal), when accessing information (the Informational), and when enjoying books (the Aesthetic).

With the acceleration of industrialization and globalization, we have stepped into an era of information explosion. Knowledge is available in greater volume and speed than ever before. The rapid advances of modern science and technology benefit human's life a great deal.

In order to obtain a good knowledge efficiently and to strengthen cooperation with many countries, scientists and engineers have an urge to communicate their ideas, discoveries and inventions, collect information and data, elucidate concepts and theorems, remark on the latest scientific advances and write experimental reports, etc. Therefore, how to develop a swift, economical, efficient, impersonal and sometimes international means of communication?

When language teachers first used the phrase "English for Science and Technology" (EST), they were content to deal superficially with scientific discourse. Instead of investigating the authentic language of science, they relied on popularized accounts of technical subjects as are found in encyclopedias or books intended for general readers. Lately, however, textbooks have been appearing that attempt to reflect the nature of the language actually used by scientists and the function it serves.

However, some people still ignore the existence of EST altogether, while others are quite



indifferent to it. They draw a simple formula like this:

EST = General English Grammar + Technical Words and Expression

They thought that they would be able to understand EST by simply knowing grammatical rules in addition to some technical words. Unfortunately, this judgment gives no fruitful comprehension about the nature of EST. They do not seem to be aware that EST presents linguistic varieties with its own characteristic features.

Since scientists and engineers try to be impersonal in narrating the natural phenomena and facts, their processes, properties and characteristics, EST must be evidently precise, concise, clear and restricted and includes many mathematical equations, formulae, diagrams, tables, etc. Scientists also prefer some typical sentence patterns and a large number of technical and semi-technical terms which make EST different to a very wide extent from ordinary English.

Furthermore, we can categorize EST literature according to its form and content. There are spoken and written forms. Like many other natural unscripted speeches, EST in spoken form or spoken EST for short has many features (hesitation, pauses, incomplete utterances, sudden changes of direction, encouraging noises from the listener and repetitions). The words and phrases used are to some extent informal and colloquial. In addition to all these, spoken EST consists obviously of a number of the technical and semi-technical terms.

You may find EST in spoken form when you listen to a lecture, a radio or television program or a film on a scientific or technical subject. Sometimes you'll have the chance to hear people "speaking scientifically" face to face.

EST in written form is used in technical books, journals or other kinds of written passages. It is expressed in the most formal way, both in the choice of words and sentences, far more formal than spoken EST.

## Unit 2 Features of EST in Style and Structure

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EST writings aim for a plain, clear, concise and accurate style and structure. EST sentences are logical in their meanings and their relationships to each other. The main features of EST in style and structure are conciseness and conditions (restrictive).

### 2.1 Conciseness

Conciseness is one of the most essential features of EST in style and structure. Scientists often want to express clearly their meanings in the least possible words. There are many different ways of achieving conciseness. Some of them are the use of non-finite verbs and other contractions.

#### 2.1.1 The Use of Non-finite Verbs

##### 1. The Use of the Gerund

The *-ing* form of the verb (Gerund) can be used to reduce time clauses or contract time statements in the following three ways:

a) When the subjects of the main clause and the time clause are the same. e. g.

“Before it is amplified, the signal should be detected.”

This time clause is very often shortened or contracted to:

“Before being amplified, the signal should be detected.”

“After we had finished the experiments, we wrote down the results.” = “After finishing the experiments, we wrote down the results.”

b) They are not normally used when the subjects are different. But one other type of statement can be expressed in the same way. e. g.

“When we remove the impurities, the water can be passed back to the boiler.”

• “Take, for example, the case of a boy sitting in a swing. When he returns to lowest point, his energy has all become kinetic energy.”

Time clauses in these two sentences can be contracted to:

“On removing the impurities, the water can be passed back to the boiler.”

“Take, for example, the case of a boy sitting in a swing. On returning to the lowest

point, his energy has all become kinetic energy. (When returning to the lowest point, his energy has all become kinetic energy.)”

From the examples above, you can see that the subjects in these time clauses are all persons.

c) The gerund (preposition + -ing) can be used to show the correct sequence of two instructions. e. g.

“Switch off the main supply. Remove the fuses.”

The economical way of expressing the two sentences are as follows:

“Before removing the fuses, switch off the main supply.” Or:

“After switching off the main supply, remove the fuses.”

The Gerund can also be used to replace an “if-clause”. e. g.

The normal expression: If machines are tested by this method, there will be some loss of power. The economical expression: The testing of machines by this method entails some loss of power.

## 2. The Use of Participle

### a) The Past Participle

- Contracted Attributive; Passive

Look at these two sentences. Each one contains a relative clause with a passive verb.

“In Britain electrical energy which is generated in power stations is fed to the National Grid.” “Supplies of rubber which was obtained from the rubber trees were not sufficient for the needs of industry.”

They are usually shortened by leaving out the word “which is” and “which was”:

“In Britain electrical energy generated in power stations is fed to the National Grid.” “Supplies of rubber obtained from the rubber trees were not sufficient for the needs of industry.”

- Short-form Relative Clauses

We can shorten a Relative Clause by using: When, Once, If, As, etc. + Past Participle

When ( While, Once, If, Unless, Though ) inverted...	= When ( While, Once, If, Unless, Though ) it is ( was, has been ) inverted ...
As shown in Figure 3 ...	= As is shown ...
As stated in the previous paragraph ...	= As has been stated ...
As just proved ...	= As has just been proved ...
As mentioned above ...	= As was mentioned ...

### b) The Present Participle

- Short-form Relative Clauses

We can omit “which is” from the following sentence:

The plane which is flying at an altitude of 2208 meters is subjected to pressures of 83

kilonewtons per square meter. = The plane flying at an altitude of 2208 meters is subjected to pressures of 83 kilonewtons per square meter.

Note, if the relative clause contains "which" + a verb in the simple present, we can omit "which" and change the verb to its *-ing* form. Some of this rule can be applied if (1) the clause is a defining one or (2) the verb is a verb of state. Verbs of state describe states not actions like "work" or "run". Some of the most common verbs of state in engineering are: measure, consist, hold, carry, weigh, contain, form.

- Using an *-ing* Clause to link a "Cause" and an "Effect" e. g.

Cause: The piston travels up the cylinder. Effect: The piston compresses the mixture.

The piston travels up the cylinder, compressing the mixture.

Cause: The gas expands suddenly. Effect: This drives the piston down the cylinder.

The gas expands suddenly, driving the piston down the cylinder.

- The Final *-ing* Clause—In place of "since"

The final *-ing* clause is an explanation to what has just been said. The subject of the second part is very often the same as the subject of the first part, and is thus omitted. e. g.

The proton is the opposite of the electron, being a particle of positive electricity. (= since it is a ...)

Mercury is most commonly used in thermometers, having a constant coefficient of expansion. (= since it has a ...)

### 3. The Use of the Infinitive

A clause may sometimes be replaced by a shorter phrase. Infinitive phrases are very useful in this way.

- a) The use of the infinitive in the expression of purpose

We can express the purpose for which something is done by using the infinitive.

When we state our purpose in doing something, we are stating our reason for doing it, or our object or aim in doing it. e. g.

We made the runways at London Airport longer. Our purpose in making it is to enable the big jets land. = We made the runways at London Airport longer to enable the big jets land. Or: The runways at London Airport were made longer to enable the big jets land.

We keep micrometers in boxes. Our object in doing this is to protect them from rust and dust. = We keep micrometers in boxes to protect them from rust and dust.

- b) The use of "in order + the infinitive" and "so as + the infinitive" in the expression of purpose e. g.

We design this unusual office block. The reason for doing this is to demonstrate the use of the new prefabricated building materials. = We design this unusual office block in order to demonstrate the use of the new prefabricated building materials. Or: We design this unusual office block so as to demonstrate the use of the new prefabricated building materials.

- c) The statement of purpose in the first part of a sentence

Very often the purpose needs to be stated first. The reason for doing this is to emphasize

its importance as the purpose for, or reason for, doing something. e. g.

We want to rid the world of pollution. So, we must make some fundamental changes in the way many of us live. = To rid the world of pollution, we must make some fundamental changes in the way many of us live. Or: To rid the world of pollution, some fundamental changes must be made in the way many of us live. Or: In order to rid the world of pollution, we must make some fundamental changes in the way many of us live.

d) The use of the infinitive in the expression of function

When we answer the question "What does x do", we describe the function of x. e. g.

What does a fuse do? It protects a circuit.

We can emphasize the function by using the Infinitive:

The function of a fuse is to protect a circuit.

## 2. 1. 2 Other Contractions

### 1. Typical Noun Constructions

The habit of the technical writers is to use nouns in constructions where we might normally use verbs. e. g.

a) Discharge of the contents of the tank is effected (performed, obtained) by a pump.

Discharge is used as a noun and a functional, "neutral" or a less meaningful verb is substituted.

b) Our bodies are heated by the consumption of sugar in the blood.

The normal expression might be: Our bodies are heated by consuming sugar in the blood. The verbal "by consuming" is changed to the noun phrase "by the consumption of".

### 2. Noun-Statements instead of Introduced Question

Noun-Statements	Introduced Questions
It is necessary to determine the efficiency of the new design.	It is necessary to examine whether the new design is efficient.
Information is needed as to which brand of canned goods is most popular.	Information is needed as to the most popular brand of canned goods.
The progress of the work will depend on how modern the equipment is.	The progress of the work will depend on the modernization of the equipment.
The type of pump used will vary according to what type of liquid is being pumped.	The type of pump used will vary according to the amount of liquid to be pumped.

### 3. Short-form Relative Clauses—with + n.

In clause which begins with "which has" or "which have", "with" may be used instead.

A telephone dial consists of a rotatable plate which has ten finger holes in it. = A telephone dial consists of a rotatable plate with ten finger holes in it.

#### 4. Short-form Relative Clauses—When, If, Once, While + Adjective e. g.

When necessary...	= When (it is) necessary ...
If possible ...	= If (it is) possible ....
Once full ...	= Once (it is) full...
While still hot ...	= While (it is) still hot ...
If any	= If (there is) any ...

#### 5. Others

As above...	As mentioned above...
As before ...	As mentioned before ...
As follows ...	As it follows ...

## 2.2 Conditions

The restriction reflects another important feature of EST in style and structure. It makes the meaning more accurate.

Here you are presented a commonly used way of obtaining restriction. In addition to the ordinary "if" clause, we can express conditions in a more restrictive way:

a) I will make the experiment providing (provided, on condition) (that) you make it by demonstration for me. (= otherwise I won't)

b) I will make the experiment only if you make it by demonstration for me. I will only do the experiment if you make it by demonstration for me. (= I won't make, unless)

c) Given, compared, granted etc. + Noun

Given plenty of labor, the job will be completed on schedule.

Given sufficient supply of electricity, the manufacturing in the auto-factory is certain to increase. (= if allowed or provided with)

## **Unit 3 Grammatical Features of EST**

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EST differs from ordinary English in the use of tense, voice, mood, word order and sentence construction.

It is assumed that the readers of EST have already had a good deal of instruction in grammar. Therefore, the principal purpose here is to show readers how to comprehend the grammar which appears most commonly in EST writing.

### **3.1 The Passive Voice in Impersonal Scientific**

Probably one-third of the verbs in EST writings are in the passive voice. The tense of these passive verbs is the Present Simple or the verb is used with modals. Scientists and engineers use the passive much more frequently than most other writers.

#### **3.1.1 Why Does the Passive Most Frequently Occur in EST**

##### **1. It Is Clearer in Meaning.**

Since scientists are more interested in action and facts than the actors, many references to people are unnecessary and confusing. Look at this sentence:

“People heat the gas carefully.”

Who are these people? The writer? The writer and his readers? All educated people? Everybody?

All these confusing questions can be avoided by using the passive:

“The gas is carefully heated.”

##### **2. It Allows Scientists to Introduce the Most Important Information at the Beginning.**

As we all know, the subject is a very important part of the sentence. In passive sentences, the subject which contains a lot of information, comes first and catches immediately the reader's attention. Example:

Electrons closer to the nucleus are held more tightly than those in the outer orbits.

##### **3. Passive Sentences Are Usually Shorter and More Concise than Active Ones.**

Compare these two sentences:

“Mathematics is used in many different fields.”

“People use mathematics in many different fields.”

It may not be difficult to find that the first sentence is shorter and more concise than the second one.

### 3.1.2 The Function of the Passive

#### 1. Stating Rules or General Principles. Examples:

The pressure that makes electrons flow along wires is called “voltage”.

All matter is made up of atoms.

Many car engines are cooled by water.

The door was opened with a key.

#### 2. Describing Procedures. Example:

The Bessemer Process uses a furnace called a “converter”. The outside of the converter is made of steel plates. The inside is lined with bricks. The converter is tipped on to its side and the charge of molten iron is poured into the top. Then the converter is put upright again. A blast of air is blown through holes in the base of the converter. This is called the “blow”.

#### 3. Passive Infinitive Is Particularly Used for Reporting News and Expressing Simple Statement of Fact. e. g.

Many pupils in school think of science as a subject containing more facts to be learnt.

The new factory is said to be opened next month.

#### 4. The Passive with Modals (Should, Must) Is particularly Common in Written Instructions, Warnings and Notices. Examples:

All library books should be returned by the end of June.

Attention must be paid to the function of the machine.

“by” is used with agents. It introduces what (or who) something is done by or the method by which it is done. “With” introduces the tool or instrument with which something is done. For example, “Written exercises are often corrected by teachers with red pens.” “The area of circle can be found by using the formula  $\pi r^2$ .” “The hole is made with a drill.” )

## 3.2 Tense

### 3.2.1 The Simple Present Tense (Timeless Present)

#### 1. Introduction

You will probably use the Simple Present Tense in most of your scientific writings. This is because scientific textbooks often contain information about scientific knowledge with no specific time reference. The Simple Present Tense is used for making generalizations. It is the most commonly used tense in EST. For example, “Carbon dioxide (CO<sub>2</sub>) consists of carbon



and oxygen." It is a universal truth. It is true at any place on the earth, at any time (the past, the present or the future) and even at any point in outer space. Therefore, this universal statement is expressed in the Simple Present, that is, in the Timeless Present.

## 2. The Usage of Present Simple

- a) It is used for regular actions or regular processes:

He studies physics six hours a week.

- b) It is used for general statement:

Action and reaction are opposite and equal.

The earth rotates itself and around the sun.

- c) It is used for factual statements and observations:

Put a straw in a glass of drinking water. Suck through the straw. The water goes up into your mouth.

The moon rotates rather slowly and so one day on the moon is as long as two weeks on the earth.

On average, women live longer than men.

- d) It can be used in descriptions of experiments:

Pucker up your lips and blow fast, and the air that passes over your hand feels cold.

The temperature rises until it reaches 100°C, but after that it remains constant.

## 3.2.2 The Simple Past Tense and the Present Perfect Tense

The Simple Past Tense and the Present Perfect Tense are used in scientific statements to refer to the past. These past tenses are used frequently in histories of science and technology, some kinds of scientific and technical reports and scientific journalism (that is, news about science and scientists).

### 1. The Use of the Simple Past

- a) It is normally used to describe actions which happened in the past and are now finished.

Consider this statement:

"Nobel cut his finger on a broken glass jar and had the answer to his problem of how to pack his explosive."

Because the Simple Past is used we know that the action is finished. We know that Nobel who died more than a hundred years ago, would never be possible to cut his finger any more.

Notice that the Simple Past is often used in conjunction with a time phrase that refers to the complete past:

Solid layers of ice moulded the lakes and hills of Europe and North America millions of years ago.

- b) It is usually used in writing technical reports.

Here are the "notes" of a simple technical report:

13/4/1970 Royal and Brown collected samples of cement type 143 from World oil /