Unit 1 3D Printing

Reading Material

3D Printing

Abstract: *The industrial revolution of the late 18th century made possible the mass production of goods, thereby creating economies of scale which changed the economy and society in ways that nobody could have imagined at the time.*[1] *Now a new manufacturing technology has emerged which does the opposite. Three-dimensional printing makes it as cheap to create a single item as it is to produce thousands of items and thus undermines economies of scale.*[2] *It may have as profound an impact on the world as the coming of the factory did.*

Key Words: **3D printing; production; principle**

The term **"3D printing"** was coined at MIT in 1995 when graduate students Jim Bredt and Tim Anderson **modified** an inkjet printer to **extrude** a binding solution onto a bed of powder, rather than ink onto paper (Figure 1-1). The ensuing **patent** led to the creation of modern 3D printing companies Z Corporation (founded by Bredt and Anderson) and ExOne.

阅读材料
译文 1

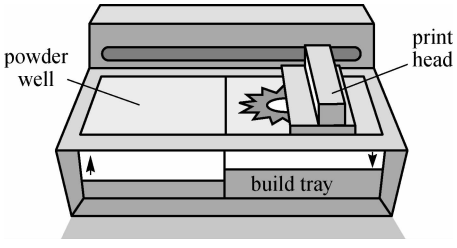

Figure 1-1 The principle model of 3D printer

教学音频

It works like this. First you call up a blueprint (**digital model**) on your computer screen and tinker with its shape and color where necessary. Then you press print. A machine nearby whirrs into life and builds up the object gradually either by depositing material from a nozzle, or by selectively solidifying a thin layer of plastic or metal dust using tiny drops of glue or a tightly focused **beam.**[3] Products are thus built up by progressively adding material, one layer at a time, hence the technology's other name, additive manufacturing. Eventually the object in question—a spare part for your car, a lampshade, a violin—pops out(Figure 1-2). The beauty of the technology is that it does not need to happen in a factory. Small items can be made by a machine like a desktop printer, in the corner of an office, a shop or even a house; big items like bicycle **frames**, panels for cars, aircraft parts need a larger machine, and a bit more space.

Figure 1-2 The components through 3D printing

The additive approach to manufacturing has several big advantages over the conventional one. It cuts costs by getting rid of production lines. It reduces waste enormously, requiring as little as one-tenth of the amount of material. It allows the creation of parts in shapes that conventional techniques cannot achieve, resulting in new, much more efficient designs in aircraft wings or heat exchangers, for example. It enables the production of a single item quickly and cheaply—and then another one after the design has been refined.

At the moment the process is possible only with certain materials (plastics, **resins** and metals) and with a precision of around a tenth of a millimeter. As with computing in the late 1970s, it is currently the preserve of **hobbyists** and workers in a few **academic** and industrial **niches**. But like computing before it, 3D printing is spreading fast as the technology improves and costs fall. A basic 3D printer, also known as a fabricator or "fabber", now costs less than a laser printer did in 1985.[4]

The technology will have implications not just for the distribution of capital and jobs, but also for intellectual-property (IP) rules. When objects can be described in a digital file,

they become much easier to copy and distribute. Just ask the music industry. When the blueprints for a new toy, or a designer shoe, escape onto the Internet, the chances that the owner of the IP will lose out are greater.

Just as nobody could have predicted the impact of the steam engine in 1750, or the printing press in 1450, or the transistor in 1950, it is impossible to foresee the long-term impact of 3D printing. But the technology is coming, and it is likely to disrupt every field it touches. Companies, regulators and entrepreneurs should start thinking about it now. One thing, at least, seems clear: although 3D printing will create winners and losers in the short term, in the long run it will expand the realm of industry.

A Words and Expressions

modify ['mɒdɪfaɪ] *v.*	修改,更改
extrude [ɪk'struːd] *v.*	(被)挤压出;喷出
patent ['pætnt] *n.*	专利;专利品
beam [biːm] *n.*	梁;光线;(电波的)波束
frame [freɪm] *n.*	框架;边框
hobbyist ['hɒbɪst] *n.*	沉溺于某种癖好者
academic [ˌækə'demɪk] *adj.*	学院的,大学的,学会的
niche [nɪtʃ] *n.*	合适的位置
resin ['rezɪn] *n.*	树脂;松香
3D printing	3D 打印
digital model	数字模型

B Special Difficulties

1. The industrial revolution of the late 18th century made possible the mass production of goods, thereby creating economies of scale which changed the economy and society in ways that nobody could have imagined at the time.

句中 thereby 意为“由此,从而”。本句可译为:18 世纪晚期的工业革命使商品的大规模生产成为可能,从而创造了规模经济,当时没人能想像到它对经济、社会所产生的影响程度。

2. Three-dimensional printing makes it as cheap to create single items as it is to produce thousands and thus undermines economies of scale.

句中…as… as… 表示单件生产与规模生产一样便宜。

3. A machine nearby whirrs into life and builds up the object gradually, either by depositing material from a nozzle, or by selectively solidifying a thin layer of plastic or metal dust using tiny drops of glue or a tightly focused beam.

句中 whirrs into life 意为“带着轻微的响声进入工作状态”。

4. A basic 3D printer, also known as a fabricator or “fabber”, now costs less than a laser printer did in 1985.

fabber 是一个免费的开源快速成型机的名字，任何人都可以登录其网站 www.fabathome.com 下载制作快速成型机 fabber 的资料。

Learn and Practice

1. Mark the following statements with T (true) or F (false) according to the text.

(1) The industrial revolution of the late 18th century made the mass production of goods impossible. (　　)

(2) The process of 3D printing is possible only with plastics. (　　)

(3) We have predicted the impact of 3D printing. (　　)

2. Choose the best answer according to the text.

(1) It works like this. First you call up a blueprint, a (　　) model on your computer screen and tinker with its shape and color where necessary.

A. code　　B. digital　　C. coded

(2) The ensuing patent (　　) to the creation of modern 3D printing companies Z Corporation (founded by Bredt and Anderson) and ExOne.

A. led　　B. used　　C. made

(3) Products are thus built up by progressively adding materials, one layer at a time: hence the technology's other name, (　　) manufacturing.

A. additives　　B. cumulative　　C. additive

(4) The term “3D printing” was coined at (　　) in 1995.

A. MIT　　B. Harvard　　C. Yale

(5) At the moment the process is possible only with certain materials (plastics, resins and metals) and with a precision of around a (　　) of a millimeter.

A. 10th　　B. ten　　C. 100th

3. Translate the following phrases into Chinese.

(1) additive manufacturing

(2) intellectual-property (IP)

(3) long-term impact

Extensive Reading

Advanced Manufacturing Technology

泛读材料
译文 1

Progress in human society has been accomplished by the creation of new technologies. The last few years have **witnessed unparalleled** changes throughout the world.[1] Rapid changes in the markets demand **drastically** shortened product life cycles and high-quality products at competitive prices. Customers now prefer a large variety of products. This **phenomenon** has **inspired** manufacturing firms to look for progressive computerized automation in various processes. Thus mass production is being replaced by low-volume, high-variety production. Manufacturing firms have recognized the importance of flexibility in the manufacturing system to meet the challenges posed by the **pluralistic** market. The concept of flexibility in manufacturing systems has attained significant importance in meeting the challenges for a variety of products of shorter **lead-times**, together with higher productivity and quality. The flexibility is the underlying concept behind the transition from traditional methods of production to the more automated and **integrated** methods (Figure 1-3). They stress that firms **implementing** automation projects should **prioritize** their needs for different flexibilities for long-range strategic perspectives.

Figure 1-3 AMT in production

Numerous definitions of AMT exist. For example, Baldwin (1995) defines AMT as a group of integrated hardware-based and software-based technologies, which if properly implemented, monitored, and **evaluated**, will lead to improving the **efficiency** and effectiveness of the firm in manufacturing a product or providing a service. AMT, defined broadly, is a total socio-technical system where the adopted **methodology** defines the **incorporated** level of technology. AMT employs a family of computer aided manufacturing (CAM), flexible manufacturing systems (FMS) (Figure 1-4), manufacturing resource planning (MRP),

automated material handling systems, robotics, computer numerically controlled (CNC) machines, computer-integrated manufacturing (CIM) systems, **optimized** production technology (OPT), and just-in-time (JIT).[2] Although AMT places great **emphasis** on the use of technological innovation, management's role is significant since AMT systems require continual review and readjustment.

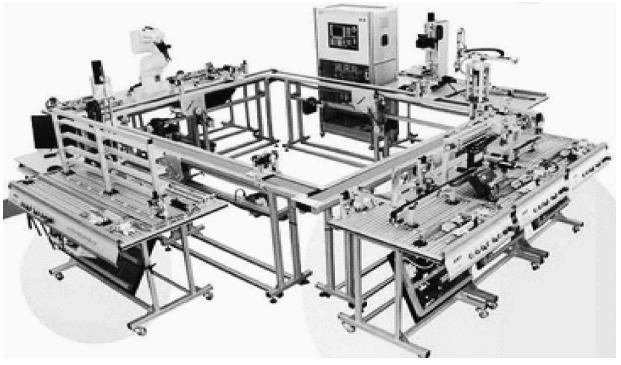

Figure 1-4 Flexible manufacturing systems

The properties(which were) inherent in advanced manufacturing technology (AMT) create new opportunities for firms, and in particular small firms in the local context.[3] The capability of this technology to modify production specifications quickly and accurately means that firms can customize their products and attain economics of scope based on low volume and low cost production. While traditionally technology has been **perceived** merely as a tool in implementing business strategy, AMT has the potential to directly affect the firm's strategy choices. **To date**, AMT literature suggests that adoption of AMT offers firms the potential to pursue new innovative strategies.

Words and Expressions

witness ['wɪtnɪs] *v.*	做证;表示
unparalleled [ʌn'pærəleld] *adj.*	无比的,无双的
drastically ['dræstɪkəlɪ] *adv.*	彻底地,激烈地
phenomenon [fɪ'nɒmɪnən] *n.*	现象,事件
inspired [ɪn'spaɪəd] *v.*	鼓舞;激励
pluralistic [ˌplʊərə'lɪstɪk] *adj.*	多元化的
implementing ['ɪmplɪməntɪŋ] *v.*	实现;执行;使生效
prioritize [praɪ'ɒrɪtaɪz] *v.*	按重要性排列;优先处理

perceive [pə'si:v] *v.*	感觉;理解为
integrated ['ɪntɪgreɪtɪd] *adj.*	完整的;整体的;结合的
evaluate [ɪ'væljʊeɪt] *v.*	评价;求……的值(或数)
efficiency [ɪ'fɪʃənsɪ] *n.*	效率;能力
methodology [meθə'dɒlədʒɪ] *n.*	方法学,方法论
incorporated [ɪn'kɔ:pəreɪtɪd] *adj.*	(美)股份有限的,组成公司的
optimize ['ɒptɪmaɪz] *v.*	使最佳化,使最优化
emphasis ['emfəsɪs] *n.*	强调,突出
lead-times	交付周期;更换模具的时间
to date	到目前为止,迄今

B Special Difficulties

1. Progress in human society has been accomplished by the creation of new technologies. The last few years have witnessed unparalleled changes throughout the world.

句中 the last few years 意为"最近的几年",也可以用 the past few years 表示过去的几年。本句可译为:新技术的创新已经让人类社会取得了发展,近几年世界发生了空前的、有目共睹的变化。

2. AMT employs a family of computer aided manufacturing (CAM), flexible manufacturing systems (FMS) (Figure 1-4), manufacturing resource planning (MRP), automated material handling systems, robotics, computer numerically controlled (CNC) machines, computer-integrated manufacturing (CIM) systems, **optimized** production technology (OPT), and just-in-time (JIT).

Optimized Production Technology(OPT)意为"最佳生产技术",是一种改善生产管理的技术,由以色列物理学家 Eli Goldratt 博士于 20 世纪 70 年代提出,它是用于安排企业生产人力和物料调度的计划方法。

Just In Time 简称 JIT,意为"准时生产方式"。准时生产方式又称为无库存生产方式(stockless production),零库存(zero inventories),一个流(one-piece flow)或者超级市场生产方式(supermarket production)。

3. The properties(which was)inherent in advanced manufacturing technology (AMT) create new opportunities for firms, and in particular small firms in the local context.

本句可译为:先进制造技术的内在优势会为企业,特别是局部地区小企业创造新的机会。

Learn and Practice

1. Mark the following statements with T (true) or F (false) according to the text.

(1)Customers prefer a large variety of products nowadays. (　　)

(2)Most manufacturing firms have not recognized the importance of flexibility in the manufacturing system. (　　)

(3)There is only one definition of AMT. (　　)

2. Translate the following passage into Chinese.

Owing to the intense global competition in manufacturing, manufacturers need to increase their level of competitiveness in the global market. Some manufacturing companies, therefore, are forced to undergo a period of transformation in order to compete more effectively. Under these circumstances, AMT is considered as a means of improving competitiveness.

Role Playing

教学音频

Background: Li Lei who works as a salesman for a company which produces 3D printer, shows their workshop and the latest development to Han Meimei, a potential customer from another firm.

Han Meimei: It was very kind of you to give me a tour of the place. It gave me a good idea of your product range.

Li Lei: It's a pleasure to show our factory to our customers. What's your general impression, may I ask?

Han Meimei: Very impressive, indeed, especially the speed of your new 3D printer.

Li Lei: That's our latest development. We put it on the market just two months ago.

Han Meimei: The machine gives you an edge over your competitors, I guess.

Li Lei: Certainly. No one can match us as far as speed is concerned.

Han Meimei: Could you give me some brochures for that machine?

Li Lei: Right. Here is our sales catalog and literature.

Han Meimei: Thank you. I think we may work together in the future.

Knowledge Link

机电英语的阅读和翻译

在机电英语的阅读理解中，文章的难度主要表现在语言、词汇、题材内容上。要把机电类英语文章的内容读懂，对文中的信息进行综合加工、概括归纳，然后得出结论。因此，它和一般意义上的普通英语文章阅读相比，难度要大得多。本章节将在分析阅读理解过程的基础上，结合阅读实例总结机电类文章的阅读方法和技巧。

一、机电英语的阅读方法

所谓阅读，实际上就是语言知识、语言技能和智力的综合运用。在阅读过程中，这三个方面的作用浑然一体、相辅相成。词汇和语法结构是阅读所必备的语言知识，但仅仅如此是难以进行有效阅读的，学生还需具备运用这些语言知识的能力，即根据上下文来确定准确词义和猜测生词词义的能力，辨认主题和细节的能力，正确理解连贯的句与句之间、段与段之间的逻辑关系的能力。这里所指的智力是学生的认知能力，包括记忆、判断和推理的能力。因为在阅读机电英语文章时常常要求领悟文章的言外之意和作者的态度、倾向等。阅读理解能力的提高是由多方面因素决定的，学生应从以下三个方面进行训练。

1. 打好语言基本功

扎实的语言基础是提高阅读能力的先决条件。首先，词汇是语言的建筑材料。提高机电英语资料的阅读能力必须扩大词汇量，尤其是掌握一定量的机电英语词汇。如果没有一定的词汇量，阅读时就会感到生词多，不但影响阅读的速度，还影响理解的程度，从而不能进行有效的阅读。其次，语法是语言中的结构关系，用一定的规则把词或短语组织到句子中，表示一定的思想。熟练掌握英语语法和惯用法也是阅读理解的基础。在阅读理解中必须运用语法知识来辨认出正确的语法关系。如果语法基础知识掌握不牢，那么在阅读中遇到结构复杂的难句、长句，就会不知所措。

2. 在阅读实践中提高阅读能力

阅读能力的提高离不开阅读实践。在打好语言基本功的基础上，还要进行大量的阅读实践。词汇量和阅读能力的提高是一种辩证关系：要想读得懂，读得快，就必须扩大词汇量；反之，要想扩大词汇量，就必须大量阅读。同样，语法和阅读之间的关系也是如此：有了牢固的语法知识就能够促进阅读的顺利进行，提高阅读的速度和准确率；反之，通过大量的阅读实践又能够巩固已掌握的语法知识。只有在大量的阅读中才能培养语感，掌握正确的阅读方法，提高阅读能力。同时，在大量的阅读中还能巩固专业知识及了解高新技术的发展趋势，这对于跟踪科学技术的发展很有好处。

3. 掌握正确的阅读方法

阅读时，注意每次视线的停顿应以一个意群为单位，而不应以一个单词为单位。要是每个单词都读，当读完一个句子或一个段落时，前面读的内容早就忘记了。这样不仅阅读速度慢，还影响理解。因此，采用正确的阅读方法可以提高阅读速度，同时提高阅读能力。常用的阅读方法有三种，即略读(skimming)、浏览(scanning)、精读(intensive reading)。

1)略读

略读(skimming)是指以尽可能快的速度进行阅读，了解文章的主旨和大意，对文章的结构和内容获得总的概念和印象。通常，400 词左右的短文要求在 6～8 分钟内完成。进行略读时精力必须特别集中，还要注意文中各细节分布的情况。在略读过程中，读者不必去读细节，遇到个别生词及难懂的语法结构也应略而不读。不要逐词逐句读，力求一目数行而能知道大概含义。略读时主要注意以下几点。

(1)注意短文的开头句和结尾句，力求抓住文章的主旨和大意。

(2)注意文章的体裁和写作特点，了解文章结构。

(3)注意了解文章的主题句及结论句。

(4)注意支持主题句或中心思想的信息句，其他细节可以不读。

在时间有限而又不想仔细了解一篇文章总的内容时，就常常需要进行略读。与浏览不同，略读不需要寻找特定的数目和名称，只是制定主题；所以进行略读的一种方法就是判定可能的主题句。在英语文章的段落中通常包含着本篇文章主题中的某一方面的信息。而每一段的第一句往往就是了解这一段落内容的线索，这样的句子就是主题句。

2)浏览

浏览(scanning)的目的主要是去找出文章中某些特定的信息，即在对文章有所了解的基础上，在文章中查找与某一问题、某一观点或某一单词有关的信息。浏览时要以很快的速度扫视文章，确定所查询的信息范围，注意所查信息的特点，如有关日期、专业词汇、某个事件、某个数字、某种观点等，寻找与此相关的关键词或关键段落。注意与所查信息无关的内容可以略过。

浏览和略读一样，也是非常重要的阅读技巧。所不同的是，略读使你对一篇文章或一本书籍的内容获得一个总的了解，而浏览可以帮助你得到特定的信息。在已经知道一篇文章或一本书籍的大概内容后，你又想从中得到某些特定问题的答案，这时，就可以应用浏览方式。浏览使你或者进行选择性阅读，或者只是得到特定信息。在通过对文章的题目、副标题和主题句进行略读后，你或者浏览感兴趣的段落，或者浏览整篇文章；但注意力只集中在你感兴趣的特定信息上。

在阅读机电文章时通常采用略读加浏览的阅读方法就可以提高阅读效率。

3)精读

精读(intensive reading)是指仔细阅读，力求对文章有深层次的理解，以获得具体的信

息，包括理解衬托主题句的细节，根据作者的意图和中心思想进行推论，根据上下文猜测词义等。对难句和长句要借助语法知识对其进行分析，达到准确的理解。总之，要想提高阅读理解能力必须掌握以下六项基本的阅读技能。

(1)掌握所读材料的主旨和大意。

(2)了解阐述主旨的事实和细节。

(3)根据上下文判断某些词汇和短语的意义。

(4)既理解个别句子的意义，也理解上下文之间的逻辑关系。

(5)根据所读材料进行一定的判断、推理和引申。

(6)领会作者的观点、意图和态度。

二、机电英语的阅读技巧

机电英语阅读对于大中专院校的学生和从事生产研发的技术人员都是十分重要的。不同的读者在阅读机电文章时有不同的方法和技巧，但作为机电文献阅读本身总是存在一定的规律，有普遍通用的方法和技巧可以遵循。

1. 紧抓主题思想

作者通常是围绕一个主题思想来组织写作材料。许多读者在获取主题思想方面有困难。或许我们都遇到过这样的情形，谈话中双方在进行争论，但是似乎任何一方都没有抓到对方的要点。与此非常相似的是，或许我们看过一段文章后还不明白作者究竟在说什么。我们可以把获取主题思想的阅读技巧分为以下四步。

1)辨认主题名词

就大多数文章而言，获取主题思想的第一步就是要确定一个最能描述作者思想中的某个人、某个地方或某件事的名词，这样的一个名词(有时是一个短语)就是主题名词。

Rocks found on the surface of the earth are divided into three classes: igneous, sedimentary, and metamorphic. Molten material becomes igneous rock when it cools. Sedimentary rocks are formed from materials deposited by glaciers, plants, animals, streams, or winds. Metamorphic rocks are rocks that once were igneous or sedimentary but have changed as a result of pressure, heat, or the deposit of material from solution.

Topic nouns: rocks; igneous; sedimentary; metamorphic

2)找出主题句

一个段落的主题句就是最能表达作者主题思想的句子，多数情况主题句位于句首，也可位于句尾，少数位于句中。

3)获取主题思想

在获取主题思想时，读者容易出现将主题的某一小部分看作主题思想，或概括的内容过多，超过了作者所表达的主题思想范围，这两种理解都是错误的。

4)避免不相关内容

读者在获取主题思想时所犯的另一个普遍错误就是头脑中出现一些与文章主题思想不相关的概念,并把它们看作文章的主题思想。在阅读文章之前读者有可能对作者表述的主题方面已有一些了解。如果读者过多地考虑已了解的那些内容,而不充分地关注作者所阐述的思想,就容易形成与文章的主题思想不相关的主题思想,尽管它本身的内容是真实的。总而言之,不能先入为主,不能用自己的想法代替文章的主题思想。试判断下面段落的主题思想是否与作者的观点相符。

Movies are actually separate still pictures shown so fast that the human eye cannot detect the break between them. When successive images are presented rapidly enough, we fuse them into single moving image.

(a)Movies are extremely popular.

(b)Modern movies make much use of slow motion.

(c)Motion pictures are separate pictures shown so fast that we see no break between them.

(d) Motion pictures require an expensive camera, capable of making very rapid multiple exposures.

2. 获取文章细节

在文章中,作者会使用细节或事实来表达和支持他们的观点。阅读要想有效果,就要能够辨认并记住文章中重要的细节。一个细节就是一个段落中的一条信息或一个事实。它们或者给段落的主题提供证据,或者为其提供例子。有些细节或事实是完整的句子,而有一些只是简单的短语。只判断出哪些是细节往往并不够。在很多情况下,还必须能区分哪些是重要细节,哪些是次要细节。想记住所有细节是不可能的,但是在阅读过程中要尽量发现重要细节并记住它们。

3. 推敲生词含义

在阅读机电英文文章时,你可能会碰到许多不认识的词汇。从英汉词典中查出它们的意思既费时又费力。在阅英文资料时不可能不查词典,但是可以通过上下文来领悟生词,从而减少查词典所用的时间。例如,作者常常用 or 这个词来引导出一个词或一个短语的定义,特别是当他认为这个词或短语对于读者来说是比较生疏时。科技文章常常会阐述一些新技术、新概念,所以在文章中常常会出现一些生词。or 这个词就像是一个信号,把新词语定义告诉你,从而可以使你不用查词典就可以明白这个新词语的意思。有时也可能用同位语来解释这个词,或用括号来说明,或用“:”来提示。在阅读机电英语时用词缀来猜出词义,知道了主干词义可通过前缀和后缀的意思来猜测不认识的词汇。

4. 了解文中指代关系

机电英语中经常使用 it 来指代名词、代词,可作形式主语或宾语,可指代某客观事物、自

然现象等，也可在文中指代上下逻辑关系。

(1)it 用作代词，指代无生命的东西、物体及抽象概念，也可指代前面出现过的名词。

The book is about science. It is not about mathematics. (It=book)

Science is my main interest. It is also my best subject. (It=science)

Science is my main interest. I know a lot about it. (It=science)

(2)it 用在习惯语中的组成部分及与天气、时间有关的非人称主语。

It is hot in the tropics.

It rains from May to October.

It was snowing last week when we got there.

(3)it 用作形式主语，起先行作用，没有具体意义。

It is known that plaque builds up on artery walls.

It has been shown that laser surgery is painless.

It has been discovered that amaranth is nutritious.

5. 把握文章对比关系

作者常用读者比较熟悉的概念或事物作为陪衬来帮助读者理解或记住其所表述的概念或事物。例如：

Unlike laser surgery, which can be performed in a doctor's office, traditional surgery must be performed in a hospital because of the danger of complications.

表示陪衬和对比的词和词组可以帮助读者理解含有生词的句子。只要认识这样的表示陪衬和对比的词语，就可以猜测出不认识的词语的意思。例如：

Most strong earthquakes in lonely outposts are not dangerous. On the other hand, even a fairly minor one in a city can cause great damage.

即使不知道 lonely outpost，你也可以根据 on the other hand 来猜出它的含义。从对比中可以看出 lonely outpost 肯定与 city 非常不同，所以意思应该是荒无人烟的地方。在阅读过程中如果特别留意这些表示陪衬和对比的词语，对文章的理解就会更深入。常见的表示对比的词有 while，however，unlikely，but，although，in contrast 和 on the other hand 等。

三、机电英语翻译概述

翻译是把一种语言已经表达出来的一切用另一种语言准确、流畅地重新表达出来。它不同于写作，译者不能随心所欲地表达自己的思想，而必须忠实、准确、通顺、完整地把原文的思想内容、感情及风格等重新表达出来。也就是说，在把原文变成另一种文字时，译者必须做到不增添、不减少、不篡改原文的本意和风格。翻译不是原文的翻版或者复制，从某种意义上说，翻译是原文的再创作。其目的是使不懂原文的读者也能够通过译文了解原文所表达的内容。机电文章的翻译要求必须文理清楚。忠实于原文并不等于死抠语法、逐词死译，而要使译文符合本民族语言的习惯，不必迁就原文语言形式。一篇修辞正确、逻辑合理、

语言简洁、文理通顺的译文，就是高质量翻译的体现。

因此，从某种意义上讲，翻译比写作还要困难。翻译固然很难，但每种语言都有其固有的特点和规律。翻译就是通过不同语言特点和规律上的对比找出相应的表达手段。在某种情况下，翻译可以是两种不同语言有规律的转换，但绝不是机械的转换和简单的变易。那种认为有了一点外语知识，加上一本词典就能进行翻译的想法是非常错误的。采用“对号入座”的办法，翻译出来的文章不是晦涩难懂，就是令人不知所云，根本算不上翻译。

机电英语诞生于 20 世纪 50 年代，是第二次世界大战后科学技术迅猛发展的产物。20 世纪 70 年代以来，机电英语在国际上引起了广泛的注意和研究，目前已经发展成一种重要的英语语体，在词汇、语法、修辞等方面具有自己的特色。对机电英语的研究始于 20 世纪 50 年代，随着科学技术的迅猛发展，人们进入了所谓的信息爆炸时代，记录和传播信息的文献资料和有声资料浩如烟海。英语是世界上使用最广泛的语言之一，机电英语既然有其特点，翻译时就有不同的要求。例如，文学作品的翻译对译文讲究文采及语言和艺术形象的动人与优美，经常运用各种意象和修辞手法（如夸张、比喻、对照等）表达作品的思想内容，要求传达出原作的神韵。但机电英语则注重科学性、逻辑性、正确性与严密性。因此，从事机电英语翻译时较少运用修辞手段，而是注重事实与逻辑，要求技术概念明确清楚，逻辑关系清晰突出，内容准确无误，资料准确精密，文字见解明了，符合技术术语的表达习惯，体现机电英语科学、准确、严谨的特征。

提高翻译水平的有效途径是进行大量的翻译实践。但是，为了使翻译实践脱离盲目性而具有更高的水平，就必须有必不可少的翻译理论和技巧作为准则与指南。通常，很少有人会期望只通过掌握某些翻译理论和技巧就可以得心应手地进行翻译，但绝不能否定翻译理论和技巧的重要性。有的人强调只要进行翻译实践就可以学会翻译，认为翻译理论可有可无，这也是片面的。翻译首先在于实践，应该在实践中学习翻译理论和常用技巧，遵循实践—认识—再实践—再认识的学习规律，不断练习，不断总结，才能有效提高翻译能力。

1. 翻译的标准

翻译的标准是衡量译文质量的尺度，又是指导翻译实践的准则。因此，翻译理论首先涉及的就是这个问题。清末翻译家严复 1898 年在《天演论》（*Evolution and Ethics and Other Essay*）的“译例言”中就提出了著名的“信、达、雅”的准则。近年来，翻译理论又有了新的发展，有的翻译家提出了文学翻译要“重神似而不重形似”，把翻译纳入了文艺美学的范畴。有的提出“译者和原作者要达到一种心灵上的契合，这种契合超越时间和空间上的限制，打破了种族上和文化上的樊笼。”有的则认为“文学翻译的最高标准是‘化’，即译文不因习惯的差异而露出牵强的痕迹，又能完全保存原有的风味，这就算得上入于‘化境’”。

对翻译的标准尽管有许多争论，但“信”和“达”，即“忠实”和“通顺”，如今已经成为公认的两条翻译标准。鲁迅先生说“凡是翻译必须兼顾两面：一则当然力求其易解，一则保存着原作的风姿”。因此，可以把翻译标准概括为“忠实、通顺”四个字。机电英语虽自有特点，其

翻译具有文体上的特殊要求，但“忠实”和“通顺”这个标准仍然是适用的。

所谓忠实，首先指译文必须忠实、正确地传达原文的内容，对原文的意思既不歪曲，也不能任意增减。内容除了指原文所叙述的事实、说明的道理、描写的景物，也包括作者在叙述、说明和描写过程中所反映的思想、观念、立场和感情。忠实这一标准对科技翻译尤为重要。科技作品的任务是准确而系统地论述科学技术问题，对准确性的要求特别严格，因此，机电英语翻译也应特别强调准确性，译文必须确切、明白，不能模糊不清，模棱两可，以免产生歧义，致使差之毫厘，失之千里。

所谓通顺，指的是译文的语言必须通顺易懂，符合汉语规范。要按照汉语的语法和习惯来选词造句，没有文理不通、结构混乱或逻辑不清的现象。理想的译文必须是纯正的中文，没有生硬拗口、中文欧化等弊病。要做到行文流畅、通顺，学习者尤其要注意避免逐字死译，生搬硬套。应该在深刻领会原文的基础上，尽量摆脱原文形式的束缚，选用符合汉语习惯的表达方法，把原意清楚、明白地表达出来。

忠实是通顺的基础，通顺是忠实的保证。不忠实原文而片面追求译文的通顺，则译文就失去了自身价值，成为无源之水，就不能称其为译文了。但是，不通顺的译文使读者感到别扭，也影响对原文的准确表达，因而也就谈不上忠实了。可见忠实与通顺是对立统一的，两者的关系反应了内容与形式的一致性。所以我们说忠实是译文质量的基础，而通顺则是译文质量的保证。

2. 翻译的方法

如果把一种语言的所有词汇作为一个词汇总集来看待，则各种词汇的分布情况和运用频率是不一样的。在词汇的总体分布中，有些词属于语言的共核部分，如功能词和日常用词，这些词构成了语言的基础词汇；此外，各个学术领域的技术术语和行业词构成了词汇总集，而各个学科领域又存在大量的行业专用表达方法和语汇，正是这些词汇在双语翻译中构成了真正的难度。在科技翻译中，一方面，准确是第一要素，如果为追求译文的流畅而牺牲准确，就会造成科技信息的丢失；另一方面，译文语言必须符合规范，用词造句应符合本民族语言习惯，要使用民族科学的、大众的语言，力求通俗易懂，不应有文理不通、逐字死译和生硬晦涩等现象。

机电文献主要为叙事说理，其特点一般是平铺直叙，结构严密，逻辑性强，公式、数据和专业术语繁多，所以专业英语的翻译应特别强调明确、通顺和简练。所谓明确，就是要在技术内容上准确无误地表达原文的含义，做到概念清楚，逻辑正确，公式、数据准确无误，符合专业要求，不应有模糊不清、模棱两可之处。专业机电文献中的一个概念、一个数据翻译错误将会带来严重的后果，甚至有巨大的经济损失。通顺不仅指选词造句应该正确，而且译文的语气表达也应正确无误，尤其是要恰当地表达出原文的语气、情态、语态、时态及所强调的重点。简练就是要求译文尽可能简短、精练，没有冗词废字，在明确、通顺的基础上力求简洁明快、精练流畅，这就是机电专业英语翻译的客观标准。一般机电英语翻译大致可分为理

解、表达、校正三个阶段。

1)理解阶段

透彻理解原著是确切表达的前提。理解原文必须从整体出发,不能孤立地看待一词一句,每种语言几乎都存在着一词多义的现象。因此,同样一个词或词组,在不同的上下文搭配中,在不同的句法结构中就可能有不同的意义。一个词、一个词组脱离上下文是不能被正确理解的。因此,译者应该结合上下文,通过对词义的选择和语法的分析,彻底弄清楚原文的内容和逻辑关系。通常情况下,理解是第一位的,表达是第二位的。正确理解原作是翻译的基础,没有正确的理解就不可能有正确的翻译。当然,即使理解了原文,但不能用准确的汉语表达出来,也无法达到忠实表达原作思想内容的目的。为了透彻理解原文,应注意结合上下文推敲词义,辨明语法,弄清句子间的关系并理解清楚原文涉及的事物。

2)表达阶段

表达就是要寻找和选择恰当的词汇,把已经理解了的原作内容重新叙述出来。表达的好坏一般取决于理解原著的深度和对归宿语言的掌握程度。理解正确并不意味着表达一定正确。表达阶段的任务就是把已经理解了的原文内容,用汉语恰如其分地重述出来。如果说在理解阶段必须"钻进去"把原文内容吃透,那么在表达阶段就必须"跳出来",不受原文形式的束缚,要放开思路,按照汉语的规律和习惯从容自如地遣词造句。在表达阶段最重要的是表达手段的选择,也就是如何"跳出来"的问题,这也是机电专业英语翻译的技巧问题。机电专业英语翻译的创造性也就表现在这方面。表达涉及的问题很多,这里介绍几种基本的翻译方法。

(1)直译。所谓直译,是指译文采取原作的表现手法,既忠于原文内容,又考虑原文形式。也就是说,在译文条件许可时,按照字面意思进行翻译,但直译绝不是逐字死译。例如:

Industrial regions of the world suffer much more acidic fall out than they did before Industrial Revolution.

世界上的工业化地区现在遭受的酸性回落物的危害,比工业革命前要大得多。

(2)意译。所谓意译,是指在译文中用创新的表现法来表现原文的逻辑内容和形象内容。当使用直译法不能使文章达到准确通顺时,就要使用意译。例如:

Light the future.

直译:点亮未来。

意译:突破现在,启迪未来。

(3)音译。有些科学术语随着历史发展和技术发展已为人们熟悉或掌握,往往由音译转为意译,或音译与意译同时采用。例如,motor(马达、电动机),modern(摩登的、现代的),microphone(麦克风、扩音器),engine(引擎、发动机),vitamin(维他命、维生素);计量单位名称一般用音译,有些在翻译时还可以简化。例如,hertz、newton、watt、volt、ohm、lux、bit、calorie 等。

(4)形译。英语原文用字母等表示事物外形时,汉语译文也按事物外形进行表示。例

如，T-square（丁字尺）、I-steel（工字钢）、cross-road（十字路口）、A-frame（A 形架）、V-slot（V 形槽）、Y-connection（星形连接）、X-ray（X 射线）等。

在翻译实践中，应根据最能忠实、通顺地表达原文含义的原则，灵活机动地选用或交替使用这两种翻译方法。翻译时应考虑到原作的整体性，最好以段而不是句为单位，一小段一小段得翻译，这不仅有利于辨别词义，而且有利于句与句的衔接、段与段的联系，译文不至成为一个个孤立句子的堆积。

3）校正阶段

校正阶段是理解和表达的进一步深化，是使译文符合标准的一个必不可少阶段，是对原文内容的进一步核实和对译文语言的进一步推敲。校对对于科技文献的译文来说尤为重要，因为机电文章要求高度精确，公式、数据较多，稍疏忽就会给工作造成严重的损失。理解和表达都不是一次完成的，而是逐步深入，最后才能达到完全理解和准确表达所反映的客观现实的目的。因此，校正译文是使译文准确翻译必不可少的一步。校正译文时，不仅要对译文做进一步的推敲，使之合乎汉语规范，而且要特别注意译文的准确性，这对机电英文作品尤其重要。因此，译文只有经过再三校改，直到符合原文意思时才能最后定稿。

Unit 2 Fundamentals of Numerical Control

Reading Material

Fundamentals of Numerical Control

Abstract: *Numerical Control (NC) is any machining process in which the operations are executed automatically in sequences as specified by the program that contains the information for the tool movements. This text describes the basic definition of numerical control and how does it works, and elaborates on the composition and function of the numerical control systems in machine control unit.*

Key Words: **numerical control; control systems; control unit**

阅读材料
译文 2

教学音频

Controlling a machine tool by means of a prepared program is known as Numerical Control or NC (Figure 2-1). NC equipment has been defined the **Electronic Industries Association** (**EIA**) as "A system in which actions are controlled by the direct insertion of numerical data at some point. The system must automatically **interpret** at least some portion of this data". [1]

In a typical NC system the numerical data which is required for producing a part is called the part program. The part program is arranged in the form of blocks of information, where each block contains the numerical data required to produce one segment of the work-piece. The block contains, in coded form, all the information needed for processing a segment of the work-piece: the segment length, its cutting speed, feed, etc. Dimensional information (length, width, and radii of circles) and the contour form (linear, circular, or other) are taken from an engineering

drawing. Dimensions are given separately for each axis of motion (x, y, etc). Cutting speed, feed-rate, and **auxiliary function** (**coolant** on and off, spindle direction, clamp, gear changes, etc) are programmed according to **surface finish** and tolerance requirements.

Figure 2-1 Numerical Control technology

Preparing the part program for a NC machine tool requires a part programmer. The part programmer must possess knowledge and experience in mechanical engineering. Part programmers must be familiar with the function of NC machine tools and machining process and have to decide on the optimal sequence of operations. [2]

In NC machine tools, each axis of motion is equipped with a separate driving device which can replace the hand-wheel of the conventional machine. [3] The driving device may be a **DC motor**, a hydraulic actuator, or a **stepping motor**. The type selected is determined mainly by the power requirements of the machine.

The NC machine tool system contains the machine control unit (MCU) and the machine tool itself. The MCU has to read and **decode** the part program, to provide the decoded instructions to the control loops of the machine axes of motion, and to control the machine tool operation.

The MCU consists of two main units: the **data processing unit** (**DPU**) and the **control loops unit** (**CLU**). The function of the DPU is to decode the information received, process it and provide data to the CLU. Such data contains the new required position of each axis, its direction of motion and velocity, and auxiliary control signals to relays. On the other hand, the CLU provides a signal announcing that the previous segment is completed and that the DPU can read a new block of the part program. The CLU operates the drives attached of the machine lead-screws and receives feedback signals on the actual position and velocity of each one of the axes. Each lead-screw is equipped with a separate driving device and a separate feedback device, but the latter exists only in a closed-loop system[4].

In CNC systems, the DPU functions are always performed by the control program contained in the CNC computer. The major part of the CLU, however, is always implemented in the most **sophisticated** CNC systems.

A Words and Expressions

interpret [ɪnˌtɜːprɪt] *v.*	解释,说明
coolant ['kuːlənt] *n.*	冷却液
decode [ˌdiː'kəʊd] *v.*	解码,译码
sophisticated [səˌfɪstɪkeɪtɪd] *adj.*	复杂的
auxiliary function	辅助功能
surface finish	表面粗糙度
DC motor	直流电机
stepping motor	步进电机
machine control unit (MCU)	机床控制单元
data processing unit (DPU)	数据处理单元
control loops unit (CLU)	控环单元
computer numerical control (CNC)	计算机数字控制
numerical control (NC)	数字控制
Electronic Industries Association (EIA)	(美国)电子工业协会

B Special Difficulties

1. NC equipment has been defined… as "A system in which actions are controlled by the direct insertion of numerical data at some point. The system must automatically interpret at least some portion of this data".

A system 是 as 的宾语。A system 后是由 which 引导的定语从句,修饰 system。本句可译为:数控设备被定义为:"采用在某些点直接插入数据来控制操作的系统,此系统至少要能自动解读部分数据。"

2. Part programmers must be familiar with the function of NC machine tools and machining process and have to decide on the optimal sequence of operations.

the optimal sequence of operations 意为"最佳的加工顺序"。本句可译为:零件编程人员要熟悉数控机床的功能及加工工艺,并决定最佳的加工顺序。

3. In NC machine tools, each axis of motion is equipped with a separate driving device which can replace the hand-wheel of the conventional machine.

which 引导的定语从句修饰 device。本句可译为:在数控机床中,每个轴向的运动都要有单独的驱动装置代替普通机床中的手轮来驱动。

4. Each lead-screw is equipped with a separate driving device and a separate feedback device, but the latter exists only in a closed-loop system.

本句可译为:每个丝杠都有一个单独的驱动装置和反馈装置,不过反馈装置只出现在闭环系统中。

Learn and Practice

1. Mark the following statements with T (true) or F (false) according to the text.

(1) In a typical NC system the numerical data which is required for producing a part is maintained on a punched tape and is called the automatic program. (　　)

(2) The DPU consists of two main units: the data processing unit (MCU) and the control loops unit (CLU). (　　)

(3) In CNC systems, the DPU functions are always performed by the control program contained in the CNC computer. (　　)

2. Choose the best choice according to the text.

(1) In (　　) machine tools, each axis of motion is equipped with a separate driving device which replaces the hand-wheel of the conventional machine.

A. DC　　B. NC　　C. CLU

(2) The NC machine tool system contains the machine control unit (　　) and the machine tool itself.

A. CLU　　B. DPU　　C. MCU

(3) The CLU operates the drives attached of the machine (　　) and receives feedback signals on the actual position and velocity of each one of the axes.

A. lead-screws　　B. screws　　C. D. C. motor

(4) The NC machine tool system contains the machine control unit (MCU) and the (　　) itself.

A. machine　　B. machine tool　　C. NC

3. Translate the following phrases into Chinese or English.

(1) 辅助功能

(2) 表面粗糙度

(3) 步进电机

(4) machine control unit

(5) data processing unit

(6)Electronic Industries Association

Extensive Reading

CNC Machine Tools

泛读材料
译文 2

NC is being used in all types of machine tools, from the simplest to the most complex. NC machine tools were developed on the basis of general-purpose machine tools. Various types of NC machine tools originated from the same types of general-purpose machine tools. Since NC machine tools have been developed for over forty years, they have many specifications and types, and their structures and functions have their own features. In order to understand NC machine tools, we introduce several main CNC machine tools simply.

1. NC Turning Machine

The Figure 2-2 shows the appearance of a NC **turning** machine. It is one of most productive machine tools. The body of NC **turning machine** includes a spindle, an **apron** and a tool post. NC system consists of CRT display, control panel and heavy-current control system.

NC turning machine has the function of simultaneous two-axis movement. Z-axis is parallel to the spindle and X-axis is perpendicular to the spindle in the horizontal plane. The Z-axis controls the **carriage** travel toward or away from the headstock. The X-axis controls the **cross motion** of the cutting tool. And with the addition of C-axis in the newest turning and **milling** machining center, the machine is used for work-pieces indexing and milling by fixing milling cutters in the carriage.

Figure 2-2 NC turning machine

2. NC Milling Machine

The NC milling machine (Figure 2-3) has always been one of the most versatile machines used in industry. Operations such as milling, **contouring**, **gear cutting**, **drilling**, **boring**, and **reaming** are only a few of the many operations. NC milling machine is suitable for processing 3D complex **curved surface**, finding wide application in automobile, **aerospace**, die equipment. In the world the first NC machine tool came from NC milling

machine. But with the development of times, NC milling machine tends to machining center. At present, because of low price, convenient and flexible operation, short time for working preparation, NC milling machine is still widely in use, classified as NC **vertical milling machine**, **horizontal milling machine** and NC copying milling machine.

Figure 2-3 NC milling machine

3. Machining Center

Machining center is a product which is formed when NC machine tools are developed to a certain stage (Figure 2-4). So far, **machining center** isn't clearly defined. NC boring and milling machines equipped with automatic tool changers are generally considered as machining centers[1]. Actually, machining center is summed up in the phrase "with automatic tool changer, capable of more processes machining." Machining center can perform milling, boring, drilling, reaming and **tapping**, which eliminates the need for a number of individual machine tools. Thus, it reduces capital and labor requirements.

Machining centers can be divided into the vertical machining center and the horizontal machining center. The **spindle** of vertical machining center is perpendicular and the spindle of horizontal machining center is horizontal. Vertical machining centers continue to be widely accepted and used, primarily for flat parts and where three-axis machining is required on a single part face such as mold and die work. Horizontal machining centers are also widely accepted and used, particularly with large, boxy, heavy parts because they lend themselves to easy and accessible **pallet** shuttle transfer when used in a cell or FMS

Figure 2-4 Machining center

application.

A work-piece can be put on a rotating table or exchanging pallet by using a fixture. Polyhedrons can be produced by the table rotating, and the exchanging of the pallet can change the machining work-pieces for improving the machining efficiency.

4. NC Drilling Machine

The Figure 2-5 shows an NC drilling machine. It can be divided into vertical NC drilling machine and horizontal NC drilling machine. NC drilling machine can perform drilling and tapping, also simple milling. Its **tool magazine** can store various tools.

Figure 2-5 NC drilling machine

5. NC Grinding Machine

NC **grinding machines** are used to machine high hardness and precision machining surfaces. They are classified as NC surface grinders, NC internal grinders and NC profile grinders.[2] With the development of automatic grinding wheel compensation, correction and grinding fixed cycle technology, the function of NC grinding machine (Figure 2-6) is stronger and stronger.

Figure 2-6 NC grinding machine

6. NC Electrical Discharge Forming Machine

Every machinist knows that on standard machine tools electrical energy is converted into motion by an electric motor. Nowadays, it has been discovered that electrical energy can be directly employed in metal removal. The NC **electrical discharge forming machine** (Figure 2-7) is a special machining method, utilizing two different polarities of electrode to generate discharge in the insulator for removing material and finishing machining. It has the special advantage in machining complex die and difficult-to-machine materials.

Figure 2-7 NC electrical discharge forming machine

7. NC Wire-cut Machine Tool

The working principle of NC **wire-cut machine tools** (Figure 2-8) is the same as the principle of electrical discharge forming machine tools. Its electrode is electrode wire and it generally uses deionized water as the processing liquid. [3]

Figure 2-8 NC wire-cut machine tool

A Words and Expressions

carriage [ˈkærɪdʒ] *n.*	刀架
aerospace [ˈeərəʊˌspeɪs] *n.*	航空航天工业
spindle [ˈspɪndl] *n.*	主轴
apron [ˈeɪprən] *n.*	溜板
contour [kənˈtʊə] *n.*	轮廓，造型
reaming [ˈriːmɪŋ] *n.*	铰削
turning [ˈtɜːnɪŋ] *n.*	车削
milling [ˈmɪlɪŋ] *n.*	铣削
drilling [ˈdrɪlɪŋ] *n.*	钻削
boring [ˈbɔːrɪŋ] *n.*	镗削
tapping [ˈtæpɪŋ] *n.*	攻螺纹
pallet [ˈpælɪt] *n.*	托盘，托板，平台
turning machine	车床
vertical milling machine	立式铣床
horizontal milling machine	卧式铣床
machining center	加工中心
electrical discharge forming machine	电火花成形机床
grinding machine	磨床
tool magazine	刀库
wire-cut machine tool	线切割机床
capital equipment	主要设备
cross motion	横向运动
gear cutting	齿轮加工
curved surface	曲面

B Special Difficulties

1. NC boring and milling machines equipped with automatic tool changers are generally considered as machining centers.

be equipped with 意为“配备有……”，equipped with automatic tool changers 是过去分词短语做后置定语，修饰 NC boring and milling machines。本句可译为：一般将带有自动换刀装置的数控镗铣床称为加工中心。

2. They are classified as NC surface grinders, NC internal grinders and NC profile grinders.

be classified as 意为“被分为……”。本句可译为:它们被分为数控平面磨床、数控内圆磨床和数控轮廓铣床。

3. Its electrode is electrode wire and it generally uses deionized water as the processing liquid.

deionized water 意为“去离子水”。本句可译为:其电极是电极丝,加工液一般采用去离子水。

Learn and Practice

1. Mark the following statements with T (true) or F (false) according to the text.

(1)In NC turning machine, X-axis is to the spindle and Z-axis is perpendicular to the spindle in the horizontal plane. ( )

(2)The NC milling machine has always been one of the most versatile machines used in industry. ( )

(3)The spindle of vertical machining center is horizontal and the spindle of horizontal machining center is perpendicular. ( )

(4)Electrical discharge forming machine has the special advantage in machining simple die and difficult-to-machine materials. ( )

(5)NC milling machines are used for machining 3D complex curved surface. ( )

(6)The working principle of NC wire-cut machine tools is not the same as the principle of electrical discharge forming machine tools. ( )

2. Choose the best answer according to the text.

(1)NC turning machine has the function of simultaneous ( )-axis movement.

A. two　　B. four　　C. five

(2)Only about 20 percent of the time was spent ( ) materials.

A. remove　　B. removing　　C. to move

(3)NC milling machines have always been one of the most versatile ( ) used in industry.

A. machining　　B. machines　　C. machine

(4) On standard machine tools electrical energy ( ) into motion by an electric motor.

A. convert　　B. is converted　　C. converts

(5)In the following aspects, all are correct except ( ).

A. NC turning, Z-axis is perpendicular to the spindle.

B. Horizontal machining centers are used for machining large, boxy, heavy parts.

C. NC electrical discharge forming machines have the special advantage in machining complex die and difficult-to-machine materials.

(6)NC milling machine is still widely in use, (　　) as NC vertical milling machine, horizontal milling machine and NC copying milling machine.

A. classify　　B. to classifying　　C. classified

3. Translate the following phrases into Chinese or English.

(1)数控车床

(2)数控铣床

(3)加工中心

(4)electrical discharge forming machine

(5)grinding machine

(6)tool magazine

Role Playing

教学音频

Background: Han Meimei is now in a factory. She is talking to Li Lei who specializes in NC machine production.

Han Meimei: Good morning, Mr. Li.

Li Lei: Hi, Meimei.

Han Meimei: What are you doing now?

Li Lei: I am turning a work-piece.

Han Meimei: Is this lathe different from that lathe?

Li Lei: Yes, It is.

Han Meimei: Where are the distinctions about them?

Li Lei: This is an NC lathe, and the other is a conventional lathe.

Han Meimei: What is NC?

Li Lei: NC refers to numerical control, controlling a machine tool by means of a prepared program.

Han Meimei: What does the NC machine tool system contain?

Li Lei: It contains the machine control unit and the machine tool itself.

Han Meimei: Do you like to machine a work-piece on NC machine tools or conventional machine tools.

Li Lei: I would prefer to use NC machine tools very much.

Han Meimei: Why do you think that?

Li Lei: Because it has some advantages such as increased productivity, reduced the noise, improved operator's safety and product quality, and so on.

Han Meimei: It sounds quite well.

Li Lei: You will like it in the future, too.

Han Meimei: I think so. Thanks a lot.

Li Lei: You are welcome.

Knowledge Link

机电文章的篇章结构

一、一般结构

在阅读一篇完整的机电专业英语时，只要仔细分析一下这类文章的篇章结构，就不难发现机电专业英语文章的一般结构由以下几部分组成。

标题 Title

目录 Contents

摘要 Abstract（包含 Key words）

引言 Introduction，Preface

正文 Body

结论与建议 Conclusions，Suggestions

总结 Summary

致谢 Acknowledgement

注释 Notes

参考文献 References

附录 Appendix

但对于一般的机电科技文章来说，不一定需要上述齐全的文体结构，可以进行取舍，一般机电科技文章的文体结构如下。

标题 Title

摘要 Abstract（包含 Key words）

引言（概述） Introduction，General Description

正文 Body

结论与建议 Results，Conclusions，Suggestions

参考文献 References

二、语言特点

1. 标题

机电文章的标题往往是文章的中心主旨，文章的标题反映了作者所研究的主要内容、所描述的科学真理和事实、所要说明的科学实验过程和产品使用说明等，其语言特征如下。

(1)关于……的研究、探讨、调查、介绍、分析、描述、说明等，其表达方式如下。

Research/study/probe… on…

Introduction/brief introduction to…

Investigation/survey/analysis/description of…

(2)说明一个科学真理和事实、实验过程、产品说明等，一般采用名词性词组或现在分词的形式，其表达方式如下。

The Miracle Chip, Machine Tools, Computer in the Future, Robots for Tomorrow, Digital Age, Information Highway, The Jet Engine, Operating System, Cloning Technology.

2. 摘要

摘要反映了一篇机电文章论述的主要内容、思想方法、重要的观点和结论等，一般摘要的长度为 150～200 单词，主要由三部分组成，即主题句、支持句和结论句，其主要语言特征如下。

(1)主题句常用句型如下。

The purpose of this paper is…

The primary goal of this research is…

The overall objective of this study is…

In this paper, we aim at…

Our goal has been to provide…

The chief aim of the present work is to investigate the facts that…

The main objective of our study has been to obtain some results…

(2)支持句常用的句型如下。

The method used in our study is known as…

The technique we applied is referred to as…

The procedure they followed can be briefly described as…

The approach adopted extensively is called…

Detailed information has been acquired by the authors using…

The research has recorded valuable data using the newly-developed method.

This is a working theory which is based on the idea that…

The fundamental feature of this theory is as follows.

The theory is characterized by…

The experiment consisted of three steps, which are described in…

The test equipment that was used consisted of…

Included in the experiment were…

(3)结论句句型如下。

In conclusion, we state that…

In summing up it may be stated that…

It is concluded that…

The results of the experiment indicate that…

The studies we have performed showed that…

The pioneer studies that the authors attempted have indicated in…

We carried out several studies that have demonstrated that…

This fruitful work gives explanation of…

The author's pioneer work has contributed to our present understanding of…

The research work has brought about a discovery of…

These findings of the research have led the author to the conclusion that…

The data obtained appear to be very similar to those reported earlier by…

3. 引言

引言是对全文的综合和概述，包括研究的背景、目的及意义，向读者介绍文章的思想和内容，常用的句型如下。

Over the past several decades…

Somebody reported…

The previous work on… has indicated that…

Recent experiments by… have suggested…

Several researchers have theoretically investigated…

In most studies of… has been emphasized with attention being given to…

Industrial use of… is becoming increasingly common…

There have been a few studies highlighting…

It is well known that…

4. 正文

正文是机电文章的主体，是科学分析和试验论证的过程反映，经常使用各种图表、公式论证作者的观点。各种图表一般翻译如下。

(1)表—Table.

(2)图—Figure/Diagram/Graph/View/Flow Diagram/Chart/Frame Figure 等。

(3)公式、算式、方程式—Formula/Equation.

(4)如图 X 所示,如表 Y 所示—As it is shown in Figure X,as it is shown in Table Y.

5. 结论

结论是对全文的总结,是经过科学的分析、研究而得出的,其语言特征如下。

The following conclusions can be drawn from…

It can be concluded that…

We may conclude that…

We come to the conclusion that…

It is generally accepted(believed,held,acknowledged) that…

We think(consider,believe,feel) that…

It is advantageous to do…

It should be realized(emphasized,stressed,noted,pointed out) that…

It is suggested(proposed,recommended,desirable)that…

It would be better(helpful,advisable) that…

6. 致谢

致谢是作者在完成论文之后表达对曾经帮助自己的人的感谢,常用的句型如下。

I am thankful to sb. for sth.

I am grateful to sb. for sth.

I am deeply indebted to sb. for sth.

I would like to thank sb. for sth.

Thanks are due to sb. for sth.

The author wishes to express his sincere appreciation to sb. for sth.

The author wishes to acknowledge sb.

The author wishes to express his gratitude for sth.

7. 参考文献

在论文最后应将参考过的主要文献一一列出,表示对别人成果的尊重及作者的写作依据。

Unit 3 NC Programming

Reading Material

NC Programming

Abstract: *NC machine tools are efficient and automatic equipment that manufacture workpieces automatically according to preparing the parts processing programs in advance. Now many traditional machines have been replaced by NC. This text is going to talk about the NC programming which is the important part of NC production.*

Key Words: **NC machine tools; NC programming; NC production**

阅读材料
译文 3

教学音频

A program for numerical control consists of a **sequence** of directions that caused a NC machine to carry out a certain operation, machining being the most commonly used process. Programming for NC may be done by an internal programming department, on the shop floor, or purchased from an outside source. Also, programming may be done manually or with computer assistance.

The program contains **instructions** and commands. Geometric instructions pertain to relative movements between the tool and the **workpiece**. Processing instructions pertain to spindle speeds, feeds, tools, and so on. Travel instructions pertain to the type of interpolation and slow or rapid movements of the tool or worktable. Switching commands pertain to on/off position for coolant supplies, spindle rotation, direction of spindle rotation, tool changes, workpiece feeding, clamping, and so on.

Manual programming: Manual part programming consists of first calculating dimensional

relationships of the tool, workpiece, and worktable, based on the engineering drawings of the part, and manufacturing operations to be performed and their sequence. A program sheet is then prepared, which consists of the necessary information to carry out the operation, such as cutting tools, spindle speeds, feeds, depth of cut, cutting fluids, power, and tool or workpiece relative positions and movements.[1] Based on this information, the part program is prepared.

Figure 3-1 NC programming

Someone knowledgeable about the particular process and able to understand, read, and change part programs can do manual programming. Because they are familiar with machine tools and process capabilities, skilled machinists can do manual programming with some training in programming, however, the work is **tedious**, and time consuming, and uneconomical and is used mostly in simple **point-to-point** applications.[2]

Computer aided programming: Computer aided part programming involves special symbolic programming languages that determine the coordinate points of corners, edges, and surfaces of the part.

Because numerical control involves the insertion of data concerning workpiece materials and **processing parameters**, programming must be done by operators or programmers who are knowledgeable about the relevant aspects of the manufacturing processes being used[3]. Before production beings, programs should be verified, either by viewing a simulation of the procession on a CRT screen or by making the part from an inexpensive material, such as **aluminum**, wood, or plastic, rather than the material specified for the finished part.

A Words and Expressions

sequence ['si:kwəns] *n.*	序列；顺序；连续
instruction [ɪn'strʌkʃn] *n.*	操作指南；指示；命令
workpiece ['wɜ:kpi:s] *n.*	工件，工作部件
debug [ˌdi:'bʌg] *v.*	排除故障
durable ['djʊərəbl] *adj.*	耐用的，耐久的
tedious ['ti:dɪəs] *adj.*	单调沉闷的，冗长乏味的
aluminum [ə'lju:mɪnəm] *n.*	铝
point-to-point	点对点
processing parameter	加工参数

B Special Difficulties

1. A program sheet is then prepared, which consists of the necessary information to carry out the operation, such as cutting tools, spindle speeds, feeds, depth of cut, cutting fluids, power, and tool or workpiece relative positions and movements.

which 引导非限定性定语从句，在这指代 a program sheet。本句可译为：准备程序清单，其中包含进行加工操作的必要信息，如切削用量、主轴速度、进给、切削深度、切削液、动力、刀具或工件的相对位置及运动，在此基础上准备零件程序。

2. Because they are familiar with machine tools and process capabilities, skilled machinists can do manual programming with some training in programming, however, the work is tedious, and time consuming, and uneconomical and is used mostly in simple point-to-point applications.

however 为连接词，表示转折。本句可译为：有经验的机械工由于熟悉机床及其工艺性能，经编程培训后也能胜任手工编程工作。不过，手工编程枯燥、费时间、经济性差，主要由于简单的点位加工。

3. Because numerical control involves the insertion of data concerning workpiece materials and processing parameters, programming must be done by operators or programmers who are knowledgeable about the relevant aspects of the manufacturing processes being used.

who 引导的定语从句，在这指代 operators or programmers。本句可译为：由于数字控制涉及有关工件材料和工艺参数信息的插入，因此编程工作必须由那些熟知所要用的工艺方面相关知识的操作人员或编程人员担任。

Learn and Practice

1. Mark the following statements with T (true) or F (false) according to the text.

(1)Programming for NC may be done by an internal programming department, on the shop floor, or purchased from an outside source. ( )

(2)The program contains geometric instructions and commands. ( )

(3) According to the text, manual part programming can prepare a program sheet. ( )

(4)Someone knowledgeable about the particular process and able to understand, read, and change part programs can do manual programming. ( )

(5)Before production beings, programs should be verified, by making the material specified for the finished part. ( )

2. Choose the best answer according to the text.

(1)NC program which is ( ) of a series of NC machine tool is a kind of processing instructions.

A. composed B. make up C. constitute

(2)Programming for NC may be done by an internal programming department, on the shop floor, or ( ) from an outside source.

A. get B. purchased C. ask for

(3) The instructions contain geometric instructions, ( ) instructions and travel instructions.

A. process B. processing C. processed

(4)The following except ( ) belongs to the manual programming.

A. a program sheet

B. process knowledge

C. computer aided programming

3. Translate the following phrases into Chinese or English.

(1)数控编程

(2)开关命令

(3)手动编程

(4)computer aided programming

(5)depth of cut

Extensive Reading

CIMS

CIMS is the abbreviation of Computer Integrated Manufacturing System. It is produced with the development of CAD and CAM. CIMS describes a new **approach** to manufacturing, management, and corporate operation.[1] Although CIM systems may include many advanced manufacturing technologies such as robotics, Computer Numerical Control (CNC), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Engineering (CAE), and Just-in-Time Production, it goes beyond these technologies.

泛读材料
译文 3

CIMS manufactures is a full automated system and computer software covering all the three major areas of CIMS: factory automation, production and process design.

CIMS includes the software and automation systems needed to perform the entire CIMS process. It includes product designing, system programming, **estimation** of production costs, actual manufacturing of products, order entry, inventory tracking, and analyses of the actual manufacturing costs.

CIMS is a real kind of **flexible** manufacturing system and can manufacture a wide variety of parts or assemblies in small-batch quantities with no physical changes to the system. This is possible because using software the programmer can easily program the **conveyor's** material routing, robot programs and CNC machine programs, the automation storage and **retrieval** system. Under the control of programs, the automatic storage and retrieval system can provide many different parts.[2] And finally the flexible conveyor uses carrier pallets and handles many different types of materials by using **interchangeable** tools.

Words and Expressions

component [kəmˌpəʊnənt] *n.*	构成;组件
approach [əˌprəʊtʃ] *n.*	方法;接近
estimating ['estɪmeɪtɪŋ] *n.*	估算,评估
flexible ['fleksəbl] *adj.*	灵活的,柔性的
conveyor [kən'veɪə] *n.*	传输;输送机
retrieval [rɪ'tri:vl] *n.*	恢复;取回
interchangeable [ˌɪntə'tʃeɪndʒəbl] *adj.*	可交换的;可交替的

B Special Difficulties

1. CIMS describes a new approach to manufacturing, management, and corporate operation.

CIMS 意为“计算机集成制造系统”。本句可译为:CIMS 描述了一种制造、管理和公司运作的新方法。

2. Under the control of programs, the automatic storage and retrieval system can provide many different parts.

under the control of 意为“在……控制下,受……的控制”。本句可译为:在程序的控制下,自动储存和检索系统可提供许多不同的零件。

C Learn and Practice

1. Translate the following phrases into Chinese or English.

(1)Agile Manufacturing

(2)Virtual Manufacturing

(3)计算机集成制造

(4)计算机辅助工程

2. Translate the following sentences into Chinese.

CIMS is a real kind of flexible manufacturing system and can manufacture a wide variety of parts or assemblies in small-batch quantities with no physical changes to the system. This is possible because using software the programmer can easily program the conveyor's material routings, robot programs and CNC machine programs, the automation storage and retrieval system.

Role Playing

教学音频

Background: Li Lei and Han Meimei are now paying a visit to the tool room of the school factory. Mr. Wang, an old master, comes over and shows them around.

Wang: Hello, everyone, welcome to this tool room. The tools, devices and all kinds of simple machines that you see are free for you to touch. While visiting, you can ask me any question. Now, come along with me and let me show you around.

Li Lei: Mr. Wang, look at the saws. Why are the two saws different both in shape and size?

Wang: Yeah. You know, the bigger one near you is called a handsaw. It is usually used by a carpenter for cutting wood. The other one over there is named a hacksaw. It is used for sawing metal pipes or ceramic titles. A hacksaw is different from a hacksaw in that it is adjustable.

Han Meimei: Mr. Wang, how interesting to see all those wrenches! They are so many kinds and quite different in size and use.

Wang: You're right. They are various both in size and look because they are used to do different things. You see, this is a 6-inch wrench. It is used for tightening furniture bolts, toilet bolts and the like. They are unadjustable. You have to use them when you repair your bikes. That one over there is a 10-inch wrench. It is adjustable. You can use an adjustable wrench to repair a car.

Li Lei: Mr. Wang, I like the drills hanging over there. It seems to me that a drill, especially an electric one, is so much different from a screwdriver. It can move so fast like a machine.

Wang: That sounds reasonable. You can call a drill a simple machine for it can produce a movement and work on something else.

Li Lei: Excuse me, Mr. Wang, may I ask you which of these tools we will use most often?

Wang: It's up to the work you're going to do. Actually, a mechanic must be good at using all kinds of tools here you see.

Li Lei & Han Meimei: Thank you very much, we've learned quite a lot here, indeed.

Wang: You're welcome.

Knowledge Link

机电英语的句型特点

一、机电英语的句型结构

机电英语文章中的句型和普通英语文章中的句型用法基本相同，只是长难句和复合句较多。但英文中的句子不论多长或者多么复杂，如果不考虑句子之间的内在联系，按照一定规律抓住句子主干并对句子成分进行分解，都可以将长句拆分成若干简单句。一般来说，动词是英语句子的主干。由于动词的不同，英语句子的主要成分就会不同，从而形成不同句型。因此，我们要分析英语句子的结构，首先要弄清句子的类型。

1. 常见的三种基本句型

按照教学大纲要求，学生需要掌握以下三种基本句型。（注意：以下部分中 S 指代

subject 主语，V 指代 verb 动词，O 指代 object 宾语，P 指代 predicative 表语，C 指代 complement 补语，L 指代 Link Verb 系动词，DO 指代 Direct Object 直接宾语，IO 指代 Indirect Object 间接宾语。）

1）SV（主语＋谓语/不及物）结构

（1）In a hydrogen atom，an electron whirls around the nucleus at a tremendous speed.

在氢原子中，一个电子以极大的速度绕原子核旋转。

（2）Electromagnetic waves can move through great distance.

电磁波可以传播很远的距离。

2）SVO（主语＋谓语/及物＋宾语）结构

这种句型又可分为三类，分别是主语＋谓语＋宾语；主语＋谓语＋宾语＋宾语补语；主语＋谓语＋间接宾语＋直接宾语。

（1）Some computers can perform over a billion computations a second.

有些计算机每秒钟可以完成十亿次以上的运算。

（2）During war，radar enables the bombers to find their targets at night.

战争时，雷达可以帮助轰炸机在黑夜里找到目标。

（3）These new methods will make the electronic devices of the future quite small.

这些新方法将使将来的电子器件变得很小。

（4）The turbo jet and the turboprop give airplanes an even thrust.

涡轮喷气发动机和涡轮螺旋发动机给飞机提供平稳的推力。

（5）This gives the work a good finish.

这使工件有良好的光洁度。

3）SVC（主语＋系动词＋表语）

（1）The laser is really amazingly simple in construction.

激光器在结构上是惊人的简单。

（2）At about 1 300 degrees the metal becomes plastic.

在大约 1 300 ℃时，金属变成塑性体。

2. 并列句和复合句的基本类型

如果句子中出现不止一个主谓结构，就要用连词组成并列句或复合句。以由两个分句组成句子为例，按照主谓结构安排有以下几种句型。

1）（主语＋谓语）＋（连词＋主语＋谓语）

（1）Most sonar sets send out sounds that are millions of times more powerful than a shout.

多数声纳装置发出的声音比喊叫声要强数百万倍。

（2）A box resting on the floor has more than one force acting on it，but they do not

produce a change in its position.

一个放在木板上的箱子有不止一个力作用于它，但是这些力并不使箱子的位置发生变化。

2)(连词＋主语＋谓语)＋(主语＋谓语)

(1)As load is added, the active component of the current increases.

加上负载后，有效电流增大。

(2)As we know, there are two kinds of steel, carbon steel and alloy steel.

正如我们所知，钢有两种：碳钢和合金钢。

3)主语＋(连词＋主语＋谓语)＋谓语

(1)An earth satellite, whether it is natural or artificial, is held in orbit by the balance of gravity and the satellite's inertiA.

地球卫星，不管是天然的还是人造的，都靠地心引力与卫星的惯性之间的平衡固定在轨道上。

(2)The petrol you use to drive your car engine is fined product of crude oil.

你开动汽车发动机所用的汽油是从原油中提炼出来的。

4)(连词＋主语＋谓语)＋谓语

(1)That matter consists of atoms is known to all of us.

我们都知道物质由原子组成。

(2)Whether life may exist on the Moon or Mars remains a mystery.

生命能否在月球或火星上存在还是个谜。

二、机电英语的句型

1. 多重复合句

科技文体常常使用多重复合句，以便能严谨地表达复杂的思想。如果把一句话分成几个独立的句子，就有可能影响到句子之间的密切联系。所以说，多重复句是最能体现机电英语文体特点的一种句型。文章的论述性越强，多重复合句用得越多，句子也越长。多重复合句的分句之间有两种基本关系，一种是并列关系，另一种是主从关系；但是以主从关系为主。这两种关系有时也会同时出现在一个句子中。

机电英语文章中有的句子可能很长，遇到这种句子时，不要眉毛胡子一把抓，而是要进行语法分析。语法分析主要从两点入手，第一是找出谓语(谓语的形式比较明显，容易发现)，然后找出它的主语。英语句子不像汉语那样经常省略主语，而是由主语和谓语构成句子的主干。第二是找出连接词，英语和汉语的另一个不同是汉语句子分句时常常没有连接词，而英语句子的分句之间一般都有连接词连接。找出了连接词就找到了分句间的界限和它们之间的关系。这里说的连接词是广义的，包括连接代词、连接关系代词、关系副词等。当然有些连接词是通用的，读者还需要根据分句所做成分进行具体分析。

2. 被动语态

在机电英语中大量存在被动语态，由于机电英语中往往不需要明确动作的执行者是谁，一般采用被动语态来表达；但翻译时可采用主动语态。同时，机电英语之所以多用被动语态，也是为了强调所论述的客观事物。

(1)No work can be done without energy.

没有能量就不能做功。

(2)All sorts of necessaries of life can be made of plastics.

各种生活必需品都能用塑料制造。

3. 非谓语形式

机电英语中的句子一般比较简单，通常用一个谓语动词，如果有几个动作，就必须选出主要动词谓语，而将其余动词作为非谓语动词形式，才能符合英语语法要求。非谓语动词有三种：动名词、分词(包括现在分词和过去分词)和不定式。非谓语动词在机电英语简单句中的使用非常频繁。

(1)To be a true professional requires lifelong learning.

要成为一个名副其实的内行，需要学到老。此句中，有“成为”“需要”和“学”三个表示动作的词。可以看出，“需要”(require)作为主要动词谓语，其余两个动作“成为”用不定式形式 to be，而“学”用动名词形式 learning。

(2)Heating water does not change its chemical composition.

把水加热并不会改变水的化学成分。此句中有“加热”和“改变”两个动作，本句的处理方式是将“改变”(change)用作主要谓语，而将“加热”(heating)处理为动名词，连同其宾语 water 作为本句主语。

(3)Matter is anything having weight and occupying space.

任何具有重量并占有空间的东西都是物质。此句包含“是”“具有”和“占有”三个动作，将“是”(is)当谓语(系动词)，而“具有”(having)和“占有”(occupying)处理为现在分词，同它们的宾语 weight 和 space 分别构成现在分词短语，作为修饰名词 anything 的定语。

4. 词性转换

英语单词有不少多义词、多性词，既可以是名词，在经过词性转化后又可做动词、形容词、介词或者副词，表达另一个意思。如果不仔细阅读分析，在翻译过程中往往会出现错误。词性转换在机电英语中屡见不鲜，几乎每个技术名词都可转换为同义的形容词，如 capital goods(生产资料)，space rocket(宇宙火箭)。词性转换增加了机电英语的灵活性和表现力，读者必须从上下文判明用词在句中是何种词性、含义如何，才能对全句做到正确无误的理解。词性转换请读者参考本书机电英语词汇构成的相关内容。

三、句子之间的逻辑关系

在机电英语文章中，作者为了准确表达一个科学真理、一个科学事实或一个实验过程，

同时，文章是由句子、句群或段落组成的，文章的各组成部分存在一定的逻辑关系，因此往往采用一些虚词来表达文章的逻辑关系，如连词、副词、介词短语、不定式短语等，这些词多出现在句首或句中，较少出现在句尾。如果句子较长，各分句也有自己的逻辑关系词语，以更好表达句子内部之间的联系，有助于准确表达作者的思想和意图。

列举：firstly，secondly… ，finally，for one thing… (and) for another(thing)，in the first place，to begin with，initially，next，lastly，on the other hand，etc.

增补：and，and also，in addition (to)，furthermore，moreover，what is more，as well as，etc.

转折或对比：but，yet，nevertheless，instead，in fact，on the contrary，on the one hand，however，on the other hand，as a matter of fact，etc.

原因或结果：hence，therefore，thus，consequently，because of this，for this reason，in consequence，on account of this，as a result，etc.

解释：that is to say，namely，for example，for instance，such as，in other words，etc.

总结或结论：(all) in all，in conclusion，in short，in a word，in brief，on the whole，to conclude，to sum up，the result of，apparently，seemingly，undoubtedly，etc.