新世纪高校机械工程规划教材

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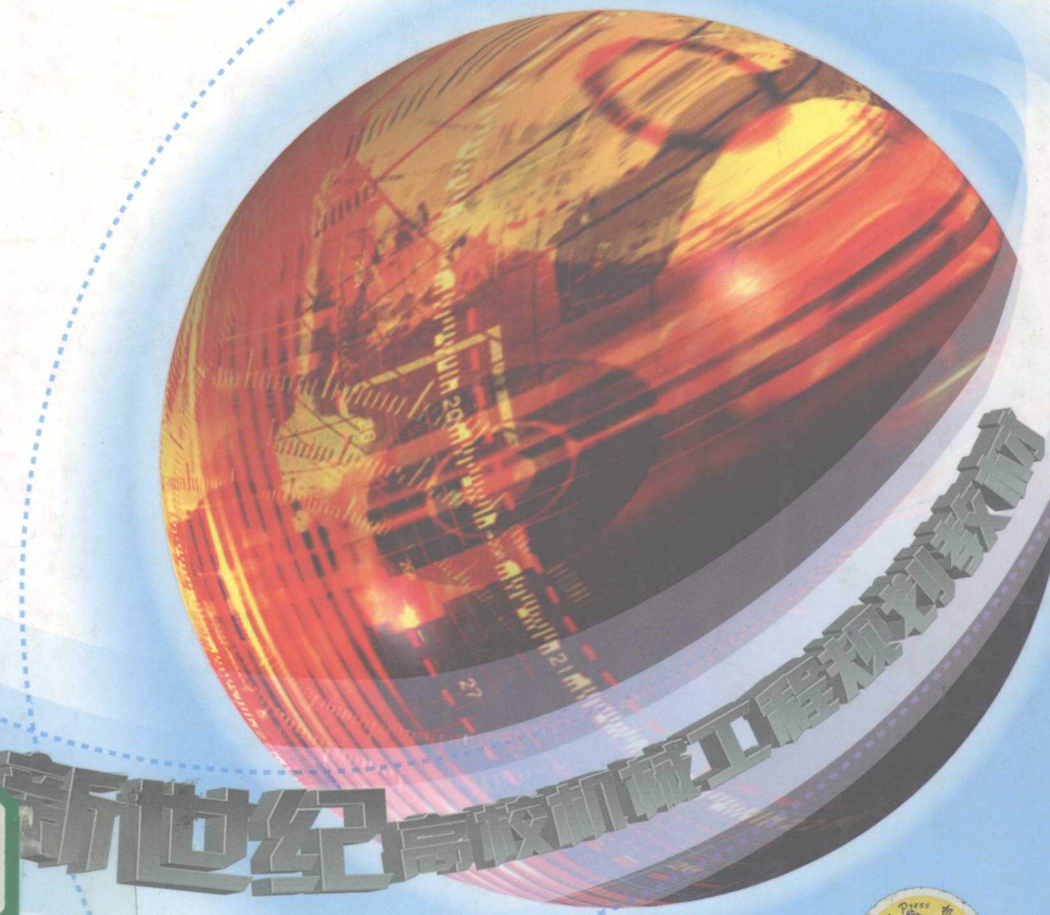
高校机械工程规划教材 新世纪

机械工程英语

（上）

主编 刘镇昌



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新世纪高校机械工程规划教材

机械工程英语（上）

主　编　刘镇昌

副主编　王仁人　刘战强

参　编　荆海鸥　王吉岱　刘喜俊

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本书分上下两册出版。上册主要涉及机械工程材料及热处理、各种热加工工艺、机械设计、金属切削机床、液压系统与元件、金属切削原理、工装设计、特种加工技术、英语应用文；下册主要涉及公差配合与计量测控、质量控制与质量体系、计算机辅助设计与制造、自动化、工业机器人、计算机集成制造及柔性制造系统、先进制造技术及其支持技术，并对科技文献的三大检索工具和有影响的主要机械工程英文期刊做了介绍。本书引用资料新颖，内容涵盖面较广，既对学生学过的内容进行必要的覆盖，也有所扩展和延伸，使学生不仅提高专业英语阅读能力，也调动学生通过英文载体了解机械工程和制造技术的现状与发展趋势。上册有阅读和口语会话练习；下册重在阅读能力的培养。全书图文并茂，适合于机械设计制造及其自动化、机电一体化、材料成形及控制、金属材料专业的本科及高职高专学生使用，对机械工程技术人员提高专业阅读能力亦不失为一本有价值的学校教材或参考书。

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新世纪高校机械工程规划教材

编审委员会

前　言

本教材是按照山东高校机械工程类规划教材编审会 2001 年 12 月会议提出的系列教材出版计划组织编写的。

本教材定名为《机械工程英语》，分上、下两册出版。每册含 6 个单元，每个单元含 4 课，每课供 2 学时使用。全书上、下册全部讲完需要 96 学时。各专业可以适当节选内容，以满足各自不同的教学要求。上册主要涉及机械工程材料及热处理、各种热加工工艺、机械设计、金属切削机床、液压系统与元件、金属切削原理、工装设计、特种加工技术、英语应用文（履历书、协议书、研究报告、讲演稿）；下册主要涉及公差配合与计量测控、质量控制与质量体系、计算机辅助设计与制造、自动化、工业机器人、先进制造技术及其支持技术，并对科技文献的三大检索工具和有影响的主要机械工程英文期刊做了介绍。

本书引用资料新颖，内容涵盖面较广。上册有阅读和会话练习；下册重在阅读能力的培养。每课均配有练习题。本书可供机械设计制造及其自动化、机电一体化、材料成形及控制、金属材料专业的本科及高职高专学生在学完基础英语以后使用；对从事上述专业的工程技术人员和管理者，亦不失为一本有价值的机械工程英语学习教材或参考书。

本书课文全部节选自欧美文献原著。为保持原著的语言风格，编者对选材一般只作删节，不作改写。本书的图不符合机械制图国家标准，但为使学生熟悉美、英等国目前仍然使用的英制单位和工程图习惯，对原著中采用的各种计量单位及图样标注均不作改动。

参加本书编写的共有山东大学、山东理工大学、山东轻工业学院、青岛建筑工程学院、山东建筑工程学院、山东科技大学共六所院校的 11 位教师。上册编写人员为山东轻工业学院王仁人（Unit1）、山东建筑工程学院荆海鸥（Unit2）、山东大学刘战强（Unit3）、山东科技大学王吉岱（Unit4、5）、山东建筑工程学院刘喜俊（Unit4、5）、山东大学刘镇昌（Unit6）。下册各单元参编人员为山东理工大学张宇（Unit1 Lesson1～3、Unit2）、山东理工大学高军（Unit1 Lesson4、Unit3）、青岛建筑工程学院刘敏杰（Unit4）、山东理工大学邢希东（Unit5）和青岛建筑工程学院王优强（Unit6）。

安徽技术师范学院项宏萍教授参加了上册 Unit6 的大部分撰稿工作；加

拿大来华的外籍教师 Keith Klockow 先生和美国的 Paul Erik Jacobson 工程师对上册会话和练习部分进行了审校，特别是 Paul Erik Jacobson 工程师非常尽心。他们的付出对本教材质量的提高起了很大作用，特此表示衷心感谢。

受编者水平所限，本书恐难免谬误，敬请读者批评指正。

刘镇昌　张宇

2002 年 10 月

目　录

Unit 1 Engineering Materials

Lesson 1 Classification of Engineering Materials

Materials are the matter of the universe. These substances have properties that make them useful in structure, machines, devices, products, and systems. The term properties describe behavior of materials when subjected to some external force or condition. Engineering materials is a term often used loosely to define most materials that go into products and systems. Engineering materials can also have a more specific meaning that refers to materials whose structure has been designed to develop specific properties for a given application.

There are nearly a limitless variety of materials. The method to understand them is to consider all materials as members of a big family. Materials that possess common characteristics are placed into their own group within the family. Although overlaps exist in the grouping system, it is easier to understand materials when relationships are identified.

Four groups, metallics, polymers, ceramics, and composites comprise the main groups; a fifth group of other materials is used for materials that do not fit well into the four groups. Each group then divides into subgroups. Within any system such as transportation, communications, or construction, numerous materials systems exist. These systems must pull materials from the groups with the material's family to meet their special needs. The wise materials user recognizes the many options available because of the compatibility between groups and then proceeds to develop a materials system that meets a specific need.

The grouping system used here follows closely grouping systems common to engineering. Slight differences exist in other grouping systems. For example, one system might divide materials into metals, polymers, ceramics, glass, wood, and concrete. Some systems divide all materials into three groups: organics, metals, and ceramics. Then they distinguish between natural and synthetic materials. Others group materials are as crystalline or amorphous. Regardless of the system, some inconsistencies develop because of the nearly limitless variety of materials. Still, the advantages of grouping outweigh the limitations.

Metals

Metallics, or metallic materials, include metal alloys. In a strict definition, metal refers only to an element such as iron, gold, aluminum, and lead. The definition used for a metal will differ depending on the field of study. Chemists might use a different definition for metals than that used by physicists.

Metals are elements that can be defined by their properties, such as ductility, toughness, malleability, electrical and heat conductivity, and thermal expansion.

Metals are also large aggregations. Metals usually have fewer than four valence electrons, as opposed to nonmetals, which generally have four to seven. The metal atom is generally much larger than the atom of the nonmetal.

Alloys consist of metal elements combined with other elements. Steel is an iron alloy made by combining iron, carbon, and some other elements. Aluminum-lithium alloys provide a 10% saving in weight over conventional aluminum alloy.

While metals comprise about three-fourths of the elements that we use, few find service in their pure form. There are several reasons for not using pure metals. Pure metals may be too hard or too soft, or they may be too costly because of their scarcity, but the key factor normally is that the desired property sought in engineering requires a blending of metals and elements. Thus, the combination forms (alloys) find greatest use. Therefore, metals and metallics become interchangeable terms. Metals are broken into subgroups of ferrous and nonferrous metals.

Ferrous Ferrous metals include iron and alloys of at least 50% iron, such as cast iron, wrought iron, steel, and stainless steel. Each of these alloys is highly dependent on possessing the element carbon. Steel is our most widely used alloy. Sheet steel forms car bodies, desk bodies, cabinets for refrigerators, stoves, and washing machines; it is used in doors, "tin" cans, shelving, and thousands of other products. Heavier steel products, such as plate, I beams, angle iron, pipe, and bar, form the structural frames of buildings, bridges, ships, automobiles, roadways, and many other structures.

Nonferrous Metal elements other than iron are called nonferrous metals. The nonferrous subgroup includes common lightweight metals such as titanium and beryllium and common heavier metals such as copper, lead, tin, and zinc.

Among the heavier metals is a group of white metals, including tin, lead, and cadmium; they have lower melting points, about 230° to 330℃. Among the high-temperature nonferrous metals are molybdenum, niobium, tantalum, and tungsten. Tungsten has the highest melting point of all metals: 3400℃. Metal alloys other than iron are called nonferrous alloys. The possible combinations of nonferrous alloys are practically endless.

Powdered Metals Alloying of metals involves melting the main ingredients together so that on cooling, the metal alloy is generally a nonporous solid. Powder metal is often used instead because it is undesirable or impractical to join the elements through alloying or to produce parts by casting or other forming processes. Powdered metal is sometimes called sintered metal. This process consists of producing small particles, compacting, and sintering. The squeezing pressure with added heat bonds the metal powder into a strong solid. Powdered metals can be ferrous, nonferrous or a combination of ferrous and nonferrous elements with nonmetallic elements.

Polymerics

Polymeric materials basically are materials that contain many parts. A polymer is a chainlike molecule made up of smaller molecular units (monomers). The monomers, made up of atoms, bond together covalently to form a polymer that usually has a carbon backbone. Thousands of polymers join together to form a plastic.

Plastics The term plastic is used to define human-made polymer resins containing carbon atoms covalently bonded with other elements, along with organic and inorganic substances. The word plastic also means moldable or workable, such as with dough or wet clay. Plastic materials are either liquid or moldable during the processing state, after which they turn to a solid. After processing, some plastics cannot be returned to the plastic or moldable state; they are thermosetting plastics or thermosets. Common thermosetting plastics include epoxy, phenolic, and polyurethane. Other plastics can be repeatedly reheated to return to the plastic state; they are thermoplastics. Examples of thermoplastic plastics are acrylics, nylon, and polyethylene.

Wood Of all the materials used in industry, wood is the most familiar and most used. Wood is a natural polymer in the same manner that polymers of ethylene are joined to form polyethylene, glucose monomers polymerize in wood to form cellulose polymers ($C_6H_{10}O_5$). Glucose is a sugar made up of carbon (C), hydrogen (H), and oxygen (O). Cellulose polymers join in layers with the glue like substance lignin, which is another polymer.

Elastomers An elastomer is defined as any polymeric material that can be stretched at room temperature to at least twice its original length and return to its original length after the stretching force has been removed. Elastomers are able to store energy, so they can return to their original length and/or shape repeatedly. Elastomers have a molecular, amorphous structure similar to that of other polymeric materials. This amorphous, or shapeless, structure consists of long coiled-up chains of giant molecules(polymers)that are entangled with each other. Adjacent polymers are not strongly bonded together. When a tensile force is applied, these coils straighten out and snap back like springs to their original coiled condition on removal of the force.

Other Natural Polymers A most amazing natural polymer is human skin, which has no equal substitute. Animal skin or hide in the form of fur and leather has limited industrial use because synthetic materials have been developed that offer greater advantages to the designer than those of the natural polymers have. Medical science continues to study such natural polymers as bones, nails, and tissues of human beings and animals to synthesize these materials for replacement when they are damaged due to injury or illness. Bioengineering and biomechanics are newer fields that integrate engineering and medicine to solve material problems in the treatment of humans.

Ceramics

Ceramics are crystalline compounds combining metallic and nonmetallic elements. Glass is grouped with ceramics because it has similar properties, but most glass is amorphous. Included in ceramics are porcelain such as pottery; abrasives such as emery used on sand-paper, refractories such as tantalum carbide, with a melting temperature of about 3870^0C, and structural clay such as brick. Ceramics, including glass, are hard, brittle, stiff, and have high melting points. Ceramics primarily have ionic bonds, but covalent bonding is also present. Silica is a basic unit in many ceramics. The internal structure of silica has a pyramid (tetrahedron) unit. These silicate tetrahedrons join into chains. The silicon atom occupies the space opening(interstice)between the oxygen atoms and shares four valence electrons with the four oxygen atoms. Chains are extremely long and join together in three dimensions. The chains are held together by ionic bonds, whereas individual silica tetrahedrals bond together covalently. Silica is combined with metals such as aluminum, magnesium, and other elements to form a variety of ceramic materials.

Composites

A composite is a material containing two or more integrated materials, with each material keeping its own identity. Normally, combining of the materials serves to rectify weaknesses possessed by each constituent when it exists alone.

Most of the groups of the family of materials could be classed as composites because of the way they are placed in service; the composite classification commonly refers to materials developed to meet the demands in building, electronic, aerospace, and auto industries. With an even increasing use of composites, they are truly the material of today and the near future because composites can be designed to be stronger, lighter, stiffer, and more heat resistant than natural materials or to possess properties required by technology that are not available in a single material.

The subgroups of composites include polymer based, metallic based, ceramic based, cermets, and others. It is also possible to classify composites by their structure. Composite structures include layers, fibers, particles, and any combination of the three. Layered composites consist of lamination alike a sandwich. The laminations are usually bonded together by adhesives, but other forces could be used, such as those provided by welding. Fibers and particles are integrated into composites by suspending them in a matrix or by the use of cohesive forces. The matrix is the material component, such as plastic, epoxy cement, rubber, or metal, that surrounds the fibers or particles. Cohesive forces involve the molecular attraction of one constituent to the other.

Other Materials

This group is used to include materials that do not fit well into the groups discussed previously. Each major group of our family of materials has some materials from a newly evolving subgroup known as intelligent material systems.

Intelligent materials systems, smart materials, or smart structures are materials and material systems designed to mimic biological organisms and offer the ultimate material system that can place control and feedback into a material structure. These materials take their cue from biological elements such as muscles, nerves, and bodily control systems that adapt to environmental changes. Just as alchemists long yearned to turn lead into gold, so too, materials scientists and engineers seek to endow materials with abilities such as 1) making controlled adaptations to changes in stress or heat, 2) making self repairs, and 3) providing feedback information on conditions that may have caused a materials failure.

Biological structures have evolved over the millennia, and we can learn from their traits and have begun to imitate nature with designs of synthetic materials. Some of the design goals for smart materials and intelligent structures follow:

Cost-efficient, durable structures whose performances match demands on the structure.

Change properties, color, shape, and manner to handle external physical loads to repair damage or make repair from damage.

Possess the five senses of smell, taste, hearing, sight, and touch.

Allow structures to learn, grow, survive, and age with grace and simplicity.

Transmit information back to designers and user.

Incorporate adaptive features and intelligence to reduce mass and energy needs.

Allow for specification of materials and structural requirements to arrive at designs that are affordable while fulfilling design objectives.

New Words and Expressions

1. metallic [mi'tælik] a. 金属（性）的
2. polymer ['pɔlimə (r)] n. 聚合物
3. composite ['kɔmpəzit] a. 混合的，合成的，复合的 n. 复合材料，合成物
4. compatibility [kəmˌpæti'biliti] n. 相容性，互换性
5. synthetic [sin'θetik] a. 合成的，综合的 n. 化学合成物，合成物
6. crystalline ['kristəlain] a. 结晶的，晶状的 n. 结晶体，晶态，晶体
7. amorphous [ə'mɔːfəs] a. 非晶体的，无定形的，非晶形
8. ductility [dʌk'tiləti] n. 可延展性，延伸度，可锻性
9. toughness ['tʌfnis] n. 韧性，韧度，刚性
10. malleability [ˌmæliəu'biliti] n. 可塑性，延展性，展性
11. titanium [tai'teiniəm] n. 钛（元素符号 Ti）
12. beryllium [bə'riliəm] n. 铍（元素符号 Be）
13. molybdenum [mə'libdinəm] n. 钼（元素符号 Mo）

14. niobium [nai'əubiəm] n. 铌（元素符号 Nb）
15. tantalum ['tæntələm] n. 钽（元素符号 Ta）
16. tungsten ['tʌŋst(ə)n] n. 钨（元素符号 W）
17. lithium ['liθiəm] n. 锂（元素符号 Li）
18. cadmium ['kædmiəm] n. 镉（元素符号 Cd）
19. conductivity [kʌndʌk'tiviti] n. 传导率，传导性
20. aggregation [ægri'geiʃən] n. 聚合，凝集，聚集，聚积作用，集合体
21. ferrous ['ferəs] a. 铁的， 含铁的，
22. sintered ['sintəd] a. 烧结的，熔结的
23. nonporous ['nɔn'pɔːrəs] n. 无孔隙的，非孔隙的
24. monomer ['mɔnəmə(r)] n. 单体
25. thermosetting [ˌθəːməu'setiŋ] a. 热固（性）的 n. 热固性，热固性塑料
26. resin ['rezin] n. 树脂，松香，树脂制品，胶质 v. 涂树脂，用树脂处理
27. epoxy [i'pɔksi] n. 环氧树脂 a. 环氧的
28. phenolic [fi'nɔlik] a. 苯酚的，酚醛的，酚的 n. 酚醛塑料
29. polyurethane [ˌpɔli'juəriθein] n. 聚氨基甲酸酯
30. thermoplastic [ˌθəːmə'plæstik] a. 热塑性的 n. 热塑性塑料
31. acrylics [ə'krilik] n. 丙烯酸纤维，丙烯酸，丙烯酸树脂
32. polyethylene [pɔli'eθiliːn] n. 聚乙烯
33. tetrahedron [ˌtetrə'hiːdrən] n. 四面体
34. glucose ['gluːkəus] n. 葡萄糖
35. elastomer [i'læstəmə(r)] n. 弹性体，合成橡胶
36. biomechanics [ˌbaiəumə'kæniks] n. 生物力学
37. scarce [skeəs] 稀缺的.

Dialogue

The Age of Materials

（Smith and Johnson are students majoring in material science. After visiting a museum of materials, they are talking about the influence of materials technology on society.）

Smith: We are living in a world of materials!

Johnson: It's true. Many advances in modern times resulted from discoveries and developments in material science.

Smith: Historically, materials technology had a major influence on society.

Johnson: Yes, periods of civilization were named after materials. Some examples are "The Stone Age", "The Bronze Age", and "The Iron Age". Do you know why they were given these names?

Smith: The Stone Age was named because people discovered flint and other stones. They used them to make fire, and as raw material for fashioning tools and weapons. It was a materials revolution, resulting in great strides for civilization.

Johnson: What about the Bronze Age?

Smith: The Bronze Age represented another great leap in materials technology. It brought about the first alloy when copper and tin were melted together. This alloy (a new metal called Bronze) was very useful for making shields, knives, ornaments and cups.

Johnson: When iron was discovered, its abundance and fine engineering properties proved it superior to bronze.

Smith: Yes. After that, steel (an alloy of iron and carbon with other elements) became the most superior engineering material.

Johnson: Today, we are moving into a Scientific Age, or New Material Age, where the dominant technology is shifting away from iron and steel.

Smith: That's true. For example, many kinds of advanced materials, such as high-performance ceramics, high-temperature ceramic superconductors, and different sorts of composites, are becoming more useful and popular.

Johnson: It is important for us to understand the similarities and differences of new developments within the main groups of materials.

Exercises

1. Answer the following questions:

1) To which family group do materials with large chainlike molecules consisting of smaller molecules or monomers belong? Are they generally amorphous or crystalline?
2) To what subgroup does a metal containing at least 50% iron belong?
3) What is an alloy? Give three examples.
4) Define "composites". List three composite structures.
5) List three examples of lightweight, nonferrous metals or alloys, three examples of heavier, nonferrous metals, and one example of refractory metals.
6) What is the subgroup of metals in which particles are fused by pressure and sintering heat?

2. Translate the following sentences into English:

1）机械工业用于制造产品的材料，可以分为金属材料、合成材料、陶瓷和复合材料四大类。

2）金属可分为有色金属和黑色金属。

Metals can been ~~broken~~ divided into subgroups of ferrous and nonfer meta

3）塑料可分为热固性塑料和热塑性塑料。

4）复合材料可以由两种或两种以上性质不同材料组合，保留各自的特点，得到单一材料无法比拟的、优越的综合性能。

5）当其所处的工作环境变化时，智能材料能改变其性能、颜色、形状等。