高等学校专业英语教材

机械工程专业英语教程

（第3版）

施 平 主编

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北京 · BEIJING

内 容 提 要

本书编者在前一版的基础上，汲取了多所大学在使用本书过程中提出的许多宝贵意见，对全书进行了修订和补充。本书的主要目的是使读者掌握机械工程专业英语术语及用法，培养和提高读者阅读和翻译专业英语文献资料的能力。本书的主要内容包括力学、机械零件与机构、机械工程材料、润滑与摩擦、机械制图、公差与配合、机械设计、机械制造、管理、现代制造技术、科技写作。全书共有68篇课文及10篇阅读材料，其中30篇课文有参考译文。本书提供电子课件等教学资源，读者可从华信教育资源网（www.hxedu.com.cn）免费下载。

本书可以作为机械设计制造及自动化、机械工程及自动化、机电工程等专业的专业英语教材，也可以供从事机械工程工作的工程技术人员参考使用。

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前　言

专业英语是大学英语教学的一个重要组成部分，是促进学生从英语学习过渡到实际应用的有效途径。教育部颁布的《大学英语教学大纲》明确规定专业英语为必修课程，要求通过四年不间断的大学英语学习，培养学生以英语为工具交流信息的能力。编者们根据此精神编写了本书，以满足高等院校机械工程各专业学生的专业英语学习需求。

在此次再版前，编者们汲取了多所大学在使用本书过程中提出的许多宝贵意见，对全书进行了修订和补充。本书所涉及的内容包括力学、机械零件与机构、机械工程材料、润滑与摩擦、机械制图、公差与配合、机械设计、机械制造、管理、现代制造技术、科技写作等方面。通过这本教材，学生不仅可以熟悉和掌握本专业常用的及与本专业有关的单词、词组及其用法，而且可以深化本专业的知识，从而为今后的学习和工作打下良好的基础。

全书由68篇课文和10篇阅读材料组成，其中30篇课文有参考译文。本书选材广泛，内容丰富，语言规范，难度适中，便于自学。为了方便教学，本书另配有电子教案，向采纳本书作为教材的教师免费提供（获取方式：登录电子工业出版社华信教育资源网 www.hxedu.com.cn 或电话联系 010－88254531 或邮件联系 qinshl@phei.com.cn 获得）。

本书由施平主编，参加编写工作的有李越、胡明、乔世坤、田锐、施晓东、侯双明、胡淼、陶文成，由贾艳敏担任主审。

由于编者水平有限，书中难免有不足和欠妥之处，恳请广大读者批评指正。

编　者

Contents

Lesson 1　Basic Concepts in Mechanics

The branch of scientific analysis which deals with motions, time, and forces is called mechanics and is made up of two parts, statics and dynamics. Statics deals with the analysis of stationary systems, i. e., those in which time is not a factor, and dynamics deals with systems which change with time.

When a number of bodies are connected together to form a group or system, the forces of action and reaction between any two of the connecting bodies are called constraint forces. These forces constrain the bodies to behave in a specific manner. Forces external to this system of bodies are called applied forces.

Electric, magnetic, and gravitational forces are examples of forces that may be applied without actual physical contact. A great many, if not most, of the forces with which we shall be concerned occur through direct physical or mechanical contact.[1]

Forces are transmitted into machine members through mating surfaces, e. g., from a gear to a shaft or from one gear through meshing teeth to another gear, from a V belt to a pulley, or from a cam to a follower. It is necessary to know the magnitudes of these forces for a variety of reasons. The distribution of the forces at the boundaries or mating surfaces must be reasonable, and their intensities must be within the working limits of the materials composing the surfaces. For example, if the force operating on a journal bearing becomes too high, it will squeeze out the oil film and cause metal to metal contact, overheating, and rapid failure of the bearing.[2] If the forces between gear teeth are too large, the oil film may be squeezed out from between them. This could result in flaking and spalling of the metal, noise, rough motion, and eventual failure. In the study of mechanics we are principally interested in determining the magnitude, direction, and location of the forces.

Some of the terms used in mechanics are defined below.

Force Our earliest ideas concerning forces arose because of our desire to push, lift, or pull various objects. So force is the action of one body on another. Our intuitive concept of force includes such ideas as place of application, direction, and magnitude, and these are called the characteristics of a force.

Mass is a measure of the quantity of matter that a body or an object contains. The mass of the body is not dependent on gravity and therefore is different from but proportional to its weight. Thus, a moon rock has a certain constant amount of substance, even though its moon weight is different from its earth weight. This constant amount of substance is called the mass of the rock.

Inertia is the property of mass that causes it to resist any effort to change its motion.

Weight is the force with which a body is attracted to the earth or another celestial body, equal to the product of the object's mass and the acceleration of gravity.

Particle A particle is a body whose dimensions are so small that they may be neglected.

Rigid Body A rigid body does not change size and shape under the action of forces. Actually, all bodies are either elastic or plastic and will be deformed if acted upon by forces. When the deformation of such bodies is small, they are frequently assumed to be rigid, i. e., incapable of deformation, in order to simplify the analysis. A rigid body is an idealization of a real body.

Deformable Body The rigid body assumption cannot be used when internal stresses and strains due to the applied forces are to be analyzed. Thus we consider the body to be capable of deforming. Such analysis is frequently called elastic body analysis, using the additional assumption that the body remains elastic within the range of the applied forces.

Newton's Laws of Motion Newton's three laws are:

Law 1 If all the forces acting on a body are balanced, the body will either remain at rest or will continue to move in a straight line at a uniform velocity.

Law 2 If the forces acting on a body are not balanced, the body will experience an acceleration. The acceleration will be in the direction of the resultant force, and the magnitude of the acceleration will be proportional to the magnitude of the resultant force and inversely proportional to the mass of the body.

Law 3 The forces of action and reaction between interacting bodies are equal in magnitude, opposite in direction, and have the same line of action.

Mechanics deals with two kinds of quantities: scalars and vectors. Scalar quantities are those with which a magnitude alone is associated. Examples of scalar quantities in mechanics are time, volume, density, speed, energy, and mass. Vector quantities, on the other hand, possess direction as well as magnitude. Examples of vectors are displacement, velocity, acceleration, force, moment, and momentum.

Words and Expressions

mechanics [mi'kæniks] *n.* 力学

statics ['stætiks] *n.* 静力学，静止状态

dynamics [dai'næmiks] *n.* 动力学，原动力，动力特性

i. e. 那就是，即（=that is）

gravitational [ˌgrævi'teiʃənəl] *a.* 重力的

mating ['meitiŋ] *n.*; *a.* 配合（的），配套（的），相连（的）

mating surface 啮合表面，配合表面，接触表面

e. g. 例如（=for example）

gear [giə] *n.* 齿轮，齿轮传动装置

shaft [ʃɑːft] *n.* 轴

meshing [ˈmeʃiŋ] *n.* 啮合，咬合，钩住

bearing [ˈbɛəriŋ] *n.* 轴承，支承，承载

lever [ˈliːvə 或 levə] *n.* 杠杆，操纵杆，手柄，把手

pulley [ˈpuli] *n.* 滑轮，皮带轮，滚筒

cam [kæm] *n.* 凸轮，偏心轮，样板，靠模，仿形板

magnitude [ˈmægnitjuːd] *n.* 大小，尺寸，量度，数值

compose [kəmˈpəuz] *v.* 组成，构成

journal bearing 滑动轴承，向心滑动轴承

squeeze [skwiːz] *v.* 挤压，压缩；*n.* 压榨，挤压

squeeze out 挤压，压出

flaking [ˈfleikiŋ] *n.* 薄片，表面剥落，压碎；*a.* 易剥落的

spall [spɔːl] *v.* 削，割，打碎，剥落，脱皮；*n.* 裂片，碎片

noncoincident [ˌnɔnkəuˈinsidənt] *a.* 不重合的，不一致的，不符合的

parallel [ˈpærəlel] *a.* 并行的，平行的，相同的；*n.* 平行线

resultant [riˈzʌltənt] *a.* 合的，组合的，总的；*n.* 合力，合成矢量，组合

couple [ˈkʌpl] *n.* 力偶，力矩

perpendicular [ˌpəːpənˈdikjulə] *a.* 垂直的；*n.* 垂直，正交，垂线

inertia [iˈnəːʃjə] *n.* 惯性，惯量，惰性，不活动

celestial [siˈlestʃəl] *a.* 天空的，天体的

incapable [inˈkeipəbl] *a.* 无能力的，不能的，无用的，无资格的

deformation [ˌdiːfɔːˈmeiʃən] *n.* 变形，形变，扭曲，应变

deformable [diˈfɔːməbl] *a.* 可变形的，应变的

acceleration [ækˌseləˈreiʃən] *n.* 加速度，加速度值，促进，加快

sense [sens] *n.*；*v.* 感觉，检测，显示，方向

scalar [ˈskeilə] *n.*；*a.* 数量（的），标量（的）

moment [ˈməumənt] *n.* 力矩，弯矩

momentum [məuˈmentəm] *n.* 动量，冲量

Notes

1. be concerned with 意为“涉及，与……有关”，physical contact 意为“实际接触，直接接触”。全句可译为：与我们有关的力，即使不是大多数的话，也有很多是通过直接的实际接触或机械接触而产生的。
2. operate on 意为“对……起作用，影响”。全句可译为：如果作用在滑动轴承上的力太大，它将会把油膜挤出，造成金属与金属的直接接触，产生过热和轴承的快速失效。

Lesson 2 Forces and Their Effects

A study of any machine or mechanism shows that each is made up of a number of movable parts. These parts transform a given motion to a desired motion. In other words, these machines perform work. Work is done when motion results from the application of force.[1] Thus, a study of mechanics and machines deals with forces and the effects of forces on bodies.

A force is a push or pull. The effect of a force either changes the shape or motion of a body or prevents other forces from making such changes. Every force produces a stress in the part on which it is applied. Forces may be produced by an individual using muscular action or by machines with mechanical motion.

Forces are produced by physical or chemical change, gravity, or changes in motion. When a force is applied which tends to stretch an object, it is called a tensile force. A part experiencing a tensile force is said to be in tension. A force can also be applied which tends to shorten or squeeze the object. Such a force is a compressive force.

A third force is known as a torsional force, or a torque since it tends to twist an object. Still another kind of force, which seems to make the layers or molecules of a material slide or slip on one another, is a shearing force.

Each of these forces may act independently or in combination. For example, a downward force applied on a vertical steel beam tends to compress the beam. If this beam is placed in a horizontal position and a load is applied in the middle, the bottom of the beam tends to stretch and is in tension. At the same time, the top area is being pushed together in compression.

The turning of a part in a lathe is another example of several forces in action (as shown in Fig. 2.1).[2] As the work revolves and the cutting tool moves into the work, the wedging action of the cutting edge produces a shear force. This force causes the metal to seem to flow off the work in the form of chips.[3] If this workpiece is held between the two centers of the lathe, the centers exert a compressive force against the work.[4] The lathe dog which drives the work tends to produce a shearing force. The pressure of the cutting tool against the work produces tension and compression, as well as a shearing action.

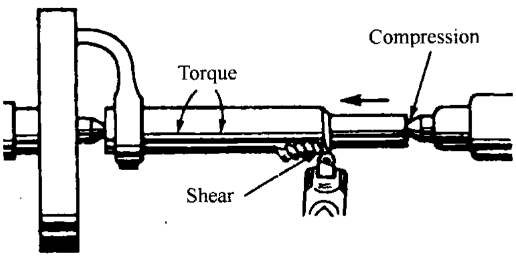

Figure 2.1 Cylindrical turning operation in a lathe

Considerable attention is given to the action of centrifugal force in grinding wheels. That is, the bonding agent that holds the abrasive particles on the wheel must be stronger than the forces which tend to make the revolving wheel fly apart at high speeds. For this reason, the speed of a grinding wheel should not exceed the safe surface speed limit specified by the manufacturer. Centrifugal force increases with speed.

The principles of centrifugal force are used in the design of centrifuge-type machines. Some centrifuges are used to separate chemicals; others are used to remove impurities in metals by centrifugal casting processes. Centrifugal force principles are also used in common appliances such as clothes dryers and in devices to control motor speeds.

Centripetal force causes an object to travel in circular path. This action is caused by the continuous application of forces which tend to pull the object to the center. In other words, the inward force which resists the centrifugal force is called the centripetal force. The centripetal force of objects spinning at a constant rate produces an acceleration toward the center which is equal and opposite to the centrifugal force (see Fig. 2.2).

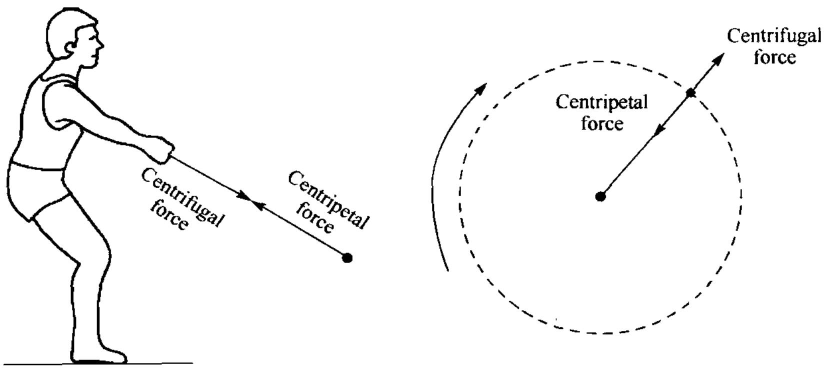

Figure 2.2 Centrifugal force and centripetal force associated with circular motion

The materials used in the construction of rapidly moving machine parts and mechanisms must be structurally strong enough to provide the centripetal force required to hold the parts to a circular path. At the same time, the materials must be able to withstand the centrifugal force which tends to pull the parts apart.

Motion and the basic laws which affect motion are important considerations because of the numerous applications of these principles to produce work through mechanical devices. There are two primary mechanical motions: rotary and rectilinear. These terms suggest that rotary motion is a circular movement around a center line and rectilinear motion is a straight line motion.

Rotary Motion. The motion that is commonly transmitted is rotary motion. This type of motion may be produced with hand tools or power tools. Rotary motion is required to drill holes, turn parts in a lathe, mill surfaces, or drive a generator or fan belt.[5]

Rectilinear Motion. The feed of a tool on a lathe, the cutting of steel on a power saw, or the shaping of materials are all situations in which rectilinear or straight line motion produces work.[6] In each of these situations a part or mechanism is used to change rotary motion to straight line motion. The screw of a micrometer (Fig. 2.3) and the threads in a nut are still other applications where the direction of motion is changed from rotary to rectilinear.[7]

Harmonic and Intermittent Motion.[8] Any simple vibration, such as the regular back-and-forth movement of the end of a pendulum, is simple harmonic motion.[9] However, many manufacturing processes require intermittent or irregular motion. For example, the fast return stroke of a power hacksaw or shaper ram is desirable because no cutting is done on the return stroke. Therefore, as more time is saved in returning the cutting tool to the working position, the less expensive is the operation.

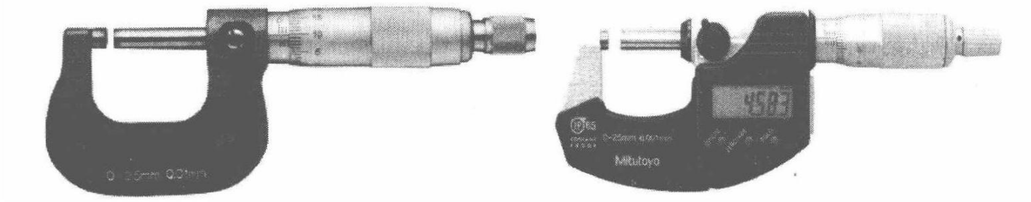

Figure 2.3 Micrometers

The combinations of rotary and rectilinear motion obtainable are unlimited because of the large variety of parts such as gears, cams, pulleys, screws, links, and belts which can be combined in many arrangements.

Words and Expressions

muscular [ˈmʌskjulə] *a.* 肌肉的
tensile [ˈtensail] *a.* 拉力的
in tension 受拉，承受拉应力
compressive [kəmˈpresiv] *a.* 有压力的，压缩的
torsional [ˈtɔːʃənəl] *a.* 扭转的，扭力的
torque [tɔːk] *n.* 扭矩，转矩
shear [ʃiə] *v.*; *n.* 剪，剪切
stretch [stretʃ] *v.* 伸长
compression [kəmˈpreʃən] *n.* 压缩，压紧
lathe [leið] *n.* 车床；*v.* 用车床加工
lathe dog 鸡心夹头，车床夹头
wedging action 楔作用，楔入作用
cutting edge 刀刃，切削刃
cutting tool 切削工具，刀具
cylindrical turning 外圆车削
centrifugal [senˈtrifjugəl] *a.* 离心的，离心力的

grinding [ˈgraindiŋ] *n.* 磨削
grinding wheel 砂轮，磨轮
bonding agent 粘合剂，结合剂
abrasive [əˈbreisiv] *n.* 研磨剂，磨料
revolving [riˈvɔlviŋ] *v.* 旋转；*a.* 旋转的
fly apart 飞散，粉碎
centrifuge [ˈsentrifjuːdʒ] *n.* 离心机，离心作用
impurity [imˈpjuəriti] *n.* 杂质，混杂物
centrifugal casting process 离心铸造法
centripetal [senˈtripitl] *a.* 向心的，利用向心力的
clothes dryer 衣物甩干机
rectilinear [ˌrektiˈliniə] *a.* 直线的，由直线组成的
intermittent [ˌintəːˈmitənt] *a.* 间歇的，断续的
reciprocating [riˈsiprəkeitiŋ] *a.* 往复的，交替的
hand tool 手工工具，手操作工具
power tool 动力工具
rotary [ˈrəutəri] *a.* 旋转的，转动的
milling [ˈmiliŋ] *n.* 铣削
shaping [ˈʃeipiŋ] *n.* 刨削
micrometer [maiˈkrɔmitə] *n.* 测微计，千分尺，微米
thread [θred] *n.* 螺纹
hamonic [hɑːˈmɔnik] *n.* 谐波，谐函数
vibration [vaiˈbreiʃən] *n.* 振动
back-and-forth 往复运动，往返运动
pendulum [ˈpendjuləm] *n.* 钟摆；*a.* 摆动的
simple harmonic motion 简谐运动
irregular motion 不均匀运动，不规则运动
return stroke 回程，返回行程
power hacksaw 弓锯床（用安装在锯弓上的机用锯条作往复运动锯削材料的锯床）
shaper [ˈʃeipə] *n.* 牛头刨床
shaper ram 牛头刨床滑枕
obtainable [əbˈteinəbl] *a.* 能获得的，可得到的

Notes

1. work 这里指“功”。全句可译为：在力的作用下产生运动就实现了做功。
2. turning of a part 这里指“对一个零件进行车削加工”。全句可译为：几个力共同作用的另外的一个例子是在车床上对零件进行车削加工（如图 2.1 所示）。

3. chip 这里指“切屑”。work 这里指“工件，即 workpiece ”。全句可译为：这个力使得金属看起来像以切屑的形式从工件上流出来一样。
4. centers of the lathe 意为“车床的顶尖”。全句可译为：如果一个工件被安装在车床的两个顶尖之间，顶尖对工件施加一个压力。
5. rotary motion 意为“回转运动”。全句可译为：钻孔，在车床上车削零件、铣平面、驱动发电机或风扇的皮带等都需要回转运动。
6. feed 这里指“进给”，shaping 这里指“采用牛头刨床（shaper）进行刨削加工”，power saw 意为“弓锯床，弓式锯床”。全句可译为：车床上刀具的进给，在弓锯床上切割钢材或者采用牛头刨床进行刨削加工都属于直线运动做功。
7. the screw of a micrometer 意为“千分尺中的螺杆”。全句可译为：千分尺中的螺杆和螺帽中的螺纹是把运动方向从转动变为直线的另外一些应用实例。
8. harmonic and intermittent motion 意为“谐和运动和间歇运动”。
9. simple harmonic motion 意为“简谐运动”。全句可译为：任何简单的振动，例如，摆的下端有规律的往复运动是简谐运动。

Lesson 3 Overview of Engineering Mechanics

As we look around us we see a world full of "things": machines, devices, tools; things that we have designed, built, and used; things made of wood, metals, ceramics, and plastics. We know from experience that some things are better than others; they last longer, cost less, are quieter, look better, or are easier to use.

Ideally, however, every such item has been designed according to some set of "functional requirements" as perceived by the designers—that is, it has been designed so as to answer the question, "Exactly what function should it perform?"[1] In the world of engineering, the major function frequently is to support some type of loading due to weight, inertia, pressure, etc. From the beams in our homes to the wings of an airplane, there must be an appropriate melding of materials, dimensions, and fastenings to produce structures that will perform their functions reliably for a reasonable cost over a reasonable lifetime.

In practice, the engineering mechanics methods are used in two quite different ways:

(1) The development of any new device requires an interactive, iterative consideration of form, size, materials, loads, durability, safety, and cost.

(2) When a device fails (unexpectedly) it is often necessary to carry out a study to pinpoint the cause of failure and to identify potential corrective measures.[2] Our best designs often evolve through a successive elimination of weak points.

To many engineers, both of the above processes can prove to be absolutely fascinating and enjoyable, not to mention (at times) lucrative.

In any "real" problem there is never sufficient good, useful information; we seldom know the actual loads and operating conditions with any precision, and the analyses are seldom exact.[3] While our mathematics may be precise, the overall analysis is generally only approximate, and different skilled people can obtain different solutions. In the study of engineering mechanics, most of the problems will be sufficiently "idealized" to permit unique solutions, but it should be clear that the "real world" is far less idealized, and that you usually will have to perform some idealization in order to obtain a solution.

The technical areas we will consider are frequently called "statics" and "strength of materials", "statics" referring to the study of forces acting on stationary devices, and "strength of materials" referring to the effects of those forces on the structure (deformations, load limits, etc.).

While a great many devices are not, in fact, static, the methods developed here are perfectly applicable to dynamic situations if the extra loadings associated with the dynamics are taken into account. Whenever the dynamic forces are small relative to the static loadings, the system is usually considered to be static.