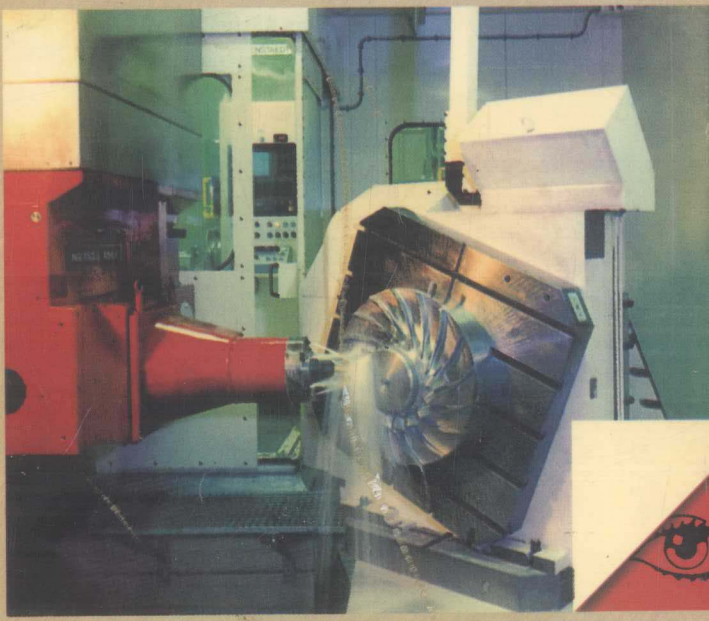
专业英语阅读

机械工程专业英语



SH READING IN MECHANICAL ENGINEERING

主编　施平

哈尔滨工业大学出版社

机械工程专业英语

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哈　尔　滨

内 容 提 要

本书以培养学生专业英语阅读能力为主要目标。内容包括：力学、机械零件与机构、机械设计、机械制造、管理、现代制造技术。全书共有30篇课文及30篇阅读材料，全部课文均附有参考译文。

本书可以作为机械设计、制造及自动化，机电工程等专业的专业英语教材，也可以供从事机械工程专业的科技人员参考使用。

机械工程专业英语

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前　言

随着信息产业的不断发展，越来越多的人们认识到语言已成为获取信息的重要手段。为了更快、更准地了解本专业的国际发展动向，学习和借鉴国外的先进技术和有效管理经验，专业外语的阅读能力已经成为高等院校学生及科研工作者所必备的素质之一。

目前，大学生们在完成了公共英语课程的学习之后，要想顺利地阅读本专业的英语书刊、文献尚存在着不少困难。编写本书的主要目的是帮助机械工程专业的学生们提高专业英语的实际应用能力。

本书所涉及的内容包括：力学、机械零件与机构、机械设计、机械制造、管理、现代制造技术等方面。通过阅读本书，学生们不仅可以熟悉和掌握本专业的专业用语和用法，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。

本书由 30 篇课文和 30 篇阅读材料组成，全部课文均有参考译文。本书选材广泛，语言规范，难度适中，便于自学。

本书由施平主编，参加编写的有贾艳敏，魏志强，王旭，张宏祥。由于水平有限，书中难免有不足和欠妥之处，恳请广大读者批评指正。

编　者

1999 年 6 月

Contents

Lesson 1
Basic Concepts in Mechanics

That 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.

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 connecting rod through a bearing to a lever, 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 sleeve bearing becomes too high, it will squeeze out the oil film and cause metal-to-metal contact, overheating, and rapid failure of the bearing. 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 dynamics we are principally interested in determining the magnitude, direction, and location of the forces.

Some of the terms used in this phase of our studies 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 acting 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.

Matter Matter is any material or substance; if it is completely enclosed, it is called a body.

Mass Newton defined mass as the quantity of matter of a body as measured by its volume and density. This is not a very satisfactory definition because density is the mass of a unit volume. We can excuse Newton by surmising that he perhaps did not mean it to be a definition. Nevertheless, he recognized the fact that all bodies possess some inherent property that is different from 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, or quantity of matter, is called the mass of the rock.

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

Weight Weight is the force of gravity acting upon a mass. The following quotation is pertinent:

The great advantage of SI units is that there is one, and only one unit for each physical quantity—the metre for length, the kilogram for mass, the newton for force, the second for time, etc. To be consistent with this unique feature, it follows that a given unit or word should not be used as an accepted technical name for two physical quantities. However, for generations the term "weight" has been used in both technical and nontechnical fields to mean either the force of gravity acting on a body or the mass of a body itself.

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

Rigid Body 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.

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 Newton's three laws are:

Law 1 If all the forces acting on a particle are balanced, the particle 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 particle are not balanced, the particle will experience an acceleration proportional to the resultant force and in the direction of the resultant force.

Law 3 When two particles react, a pair of interacting forces come into existence; these forces have the same magnitudes and opposite senses, and they act along the straight line common to the two particles.

Words and Expressions

statics ['stætiks] *n*. 静力学,静止状态
dynamics [dai'næmiks] *n*. 动力学,原动力,动力特性
mating ['meitiŋ] *n*.;*a*. 配合(的),配套(的),相连(的)
mating surface 啮合表面,配合表面
gear [giə] *n*. 齿轮,齿轮传动装置
meshing ['meʃiŋ] *n*. 啮合,咬合,钩住
bearing ['bɛəriŋ] *n*. 轴承,支承,承载
lever ['li:və 或 'levə] *n*. 杠杆,操纵杆,手柄,把手
pulley ['puli] *n*. 滑轮,皮带轮,滚筒

cam [kæm] *n*. 凸轮,偏心轮,样板,靠模,仿形板
compose [kəm'pəuz] *v*. 组成,构成
sleeve [sli:v] *n*. 套筒,轴套,衬套,空心轴
sleeve bearing 套筒轴承
squeeze [skwi:z] *v*. 挤压,压缩;*n*. 压榨,挤压
squeeze out 挤压,压出
flaking ['fleikiŋ] *n*. 薄片,表面剥落,压碎;*a*. 易剥落的
spall [spɔ:l] *v*. 削,割,打碎,剥落,脱皮;*n*. 裂片,碎片
arise [ə'raiz] (arose, arisen) *v*. 发生,产生,出现,呈现,兴起
matter ['mætə] *n*. 物质,实质
nevertheless [ˌnevəðə'les] *ad*.; *conj*. 尽管如此,虽然…但是,然而
inertia [i'nə:ʃiə] *n*. 惯性,惯量,惰性,不活动
SI unit = standard international unit 标准国际单位制
incapable [in'keipəbl] *a*. 无能力的,不能的,无用的,无资格的
deformation [ˌdi:fɔ:'meiʃən] *n*. 变形,形变,扭曲,应变
deformable [di'fɔ:məbl] *a*. 可变形的,应变的
elastic [i'læstik] *a*. 弹性的,有弹力的,有伸缩性的
acceleration [ækˌselə'reiʃən] *n*. 加速度,加速度值,促进,加快
resultant [ri'zʌltənt] *a*. 合的,组合的,总的; *n*. 合力,合量
sense [sens] *n*.; *v*. 感觉,检测,显示,方向
common to 为…所共有

Reading Material:

Mechanics

Mechanics is that branch of physical science which deals with the state of rest or motion of bodies under the action of forces. No one subject plays a greater role in engineering analysis than does mechanics. The early history of this subject is synonymous with the very beginnings of engineering. Modern research and development in the fields of vibrations,

stability and strength of structures and machines, robotics, rocket and spacecraft design, automatic control, engine performance, fluid flow, electrical machines and apparatus, and molecular, atomic, and subatomic behavior are highly dependent upon the basic principles of mechanics. A thorough understanding of this subject is an essential prerequisite for work in these and many other fields.

Mechanics is the oldest of the physical sciences. The earliest recorded writings in this field are those of Archimedes (287 ~ 212 B.C.) which concern the principle of the lever and the principle of buoyancy. Substantial progress awaited the formulation of the laws of vector combination of forces by Stevinus (1548 ~ 1620), who also formulated most of the principles of statics. The first investigation of a dynamic problem is credited to Galileo (1564 ~ 1642) in connection with his experiments with falling stones. The accurate formulation of the laws of motion, as well as the law of gravitation, was made by Newton(1642 ~ 1727), who also conceived the idea of the infinitesimal in mathematical analysis. Substantial contributions to the development of mechanics were also made by da Vinci, Varignon, Euler, D'Alembert, Lagrange, Laplace, and others.

The principles of mechanics as a science embody the rigor of mathematics upon which they are highly dependent. Thus mathematics plays an important role in achieving the purpose of engineering mechanics, which is the application of these principles to the solution of practical problems. The basic principles of mechanics are relatively few in number, but they have exceedingly wide application, and the methods employed in mechanics carry over into many fields of engineering endeavor.

The subject of mechanics is logically divided into two parts: statics, which concerns the equilibrium of bodies under the action of forces, and

dynamics, which concerns the motion of bodies.

Certain concepts and definitions are basic to the study of mechanics, and they should be understood at the outset.

Space is the geometric region occupied by bodies whose positions are described by linear and angular measurements relative to a coordinate system. For three-dimensional problems our space will require three independent coordinates. For two-dimensional problems only two coordinates will be required.

Time is the measure of the succession of events and is a basic quantity in dynamics. Time is not directly involved in the analysis of statics problems.

Mass is a measure of the inertia of a body, which is its resistance to a change of velocity. Of more importance to us in statics, mass is also the property of every body by which it experiences mutual attraction to other bodies.

Force is the action of one body on another. A force tends to move a body in the direction of its action. The action of a force is characterized by its magnitude, by the direction of its action, and by its point of application. Force is a vector quantity.

Particle A body of negligible dimensions is called a particle. In the mathematical sense a particle is a body whose dimensions approach zero so that it may be analyzed as a point mass. Also, when the dimensions of a body are irrelevant to the description of its position or the action of forces applied to it, the body may be treated as a particle.

Rigid Body A body is considered rigid when the relative movements between its parts are negligible for the purpose at hand. For instance, the calculation of the tension in the cable which supports the boom of a mobile crane under load is essentially unaffected by the small internal strains (deformations) in the structural members of the boom. For the

purpose, then, of determining the external forces which act on the boom, we may treat it as a rigid body. Statics deals primarily with the calculation of external forces which act on rigid bodies which are in equilibrium. To determine the internal stresses and strains, the deformation characteristics of the boom material would have to be analyzed. This type of analysis belongs in the study of the mechanics of deformable bodies, which comes after the study of statics.

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

physical ['fizikəl] *a*. 物质的,有形的,实际的,物理的,自然的
physical science 自然科学
synonymous [si'nɔniməs] *a*. 同义的,同义语的
be synonymous with M 和 M 同义,…的意义和 M 是一样的
vibration [vai'breiʃən] *n*. 振动,振荡
stability [stə'biliti] *n*. 平衡状态,稳定性,稳固
strength [streŋθ] *n*. 强度,抗力
robotics [rəu'bɔtiks] *n*. 机器人学,机器人技术
rocket ['rɔkit] *n*. 火箭,火箭发动机
spacecraft ['speiskrɑ:ft] *n*. 宇宙飞船,空间飞行器
subatomic ['sʌbə'tɔmik] *a*. 亚原子的,原子内的,比原子更小的
prerequisite ['pri:'rekwizit] *a*. 先决条件的,必要的;*n*. 前提,先决条件
buoyancy ['bɔiənsi] *n*. 浮力
substantial [səb'stænʃəl] *a*. 物质的,实质的,显著的,有重大价值的;*n*. 实质性东西,重要部分

await [ə'weit] *v*. 等候,等待
vector ['vektə] *n*. 矢量,向量
gravitation [ˌgrævi'teiʃən] *n*. 引力,重力,引力作用
law of gravitation 万有引力定律
conceive [kən'si:v] *v*. 设想,想像,有…想法,表达,想出
infinitesimal [ˌinfini'tesiməl] *a*. 无穷小的,极微小的;*n*. 无穷小量
embody [im'bɔdi] *v*. 具体化,体现,包括,收录,合并
rigor ['rigə] *n*. 严密,严格,精确,精密
exceedingly [ik'si:diŋli] *ad*. 非常,极其,极度地,很
endeavor [in'devə] *n*.;*v*. 努力,尽力,力图,试图
equilibrium [ˌi:kwi'libriəm] *n*. 平衡(状态,性,曲线)
outset ['autset] *n*. 开头,开始,最初
at the outset 当初,首先,一开始
geometric [ˌdʒiə'metrik] *a*. 几何的,几何图形的
coordinate [kəu'ɔ:dinit] *n*. 坐标,坐标系,相同;*a*. 坐标的,对等的
mutual ['mju:tjuəl] *a*. 相互的,共同的
mutual attraction 相互吸引
irrelevant [i'relivənt] *a*. 没关系的,不相干的,不中肯的
tension ['tenʃən] *n*. 张力,拉力,张开,拉伸; *v*. 拉伸,拉紧
boom [bu:m] *n*. 吊杆,起重杆;*v*.;*n*. 繁荣,兴旺,畅销
crane [krein] *n*. 起重机,吊车,升降设备
mobile crane 移动式起重机
stress [stres] *n*. 应力,受力状态,重点;*v*. 强调,着重,加压力
strain [strein] *n*. 应变,变形,拉紧
characteristic [ˌkærikətə'ristik] *a*. 特征的,特有的,表示特性
scalar ['skeilə] *n*.;*a*. 数量(的),标量(的)
displacement [dis'pleismənt] *n*. 位移,变位,移动,取代,代替
moment ['məumənt] *n*. 力矩,弯矩
momentum [məu'mentəm] *n*. 动量,冲量

Lesson 2
Forces and Moments

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.

Force $\boldsymbol{F}$ is a vector. The characteristics of a force are its magnitude, its direction, and its point of application. The direction of a force includes the concept of a line, along which the force is directed, and a sense. Thus, a force is directed positively or negatively along a line of action.

Two equal and opposite forces acting along two noncoincident parallel straight lines in a body cannot be combined to obtain a single resultant force. Any two such forces acting on a body constitute a couple. The arm of the couple is the perpendicular distance between their lines of action, and the plane of the couple is the plane containing the two lines of action.

The moment of a couple is another vector $\boldsymbol{M}$ directed normal to the plane of the couple; the sense of $\boldsymbol{M}$ is in accordance with the right-hand rule for rotation. The magnitude of the moment is the product of the arm of the couple and the magnitude of one of the forces.