十三五”规划教材暨智能制造领域人才培养规划教材

机械设计制造及其自动化专业英语

PROFESSIONAL ENGLISH OF MECHANICAL DESIGN, MANUFACTURING AND AUTOMATION

胡珊珊　主编

华中科技大学出版社
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内 容 简 介

本教材的阅读材料主要选材于经典的国外原文教材、国外学术著作和期刊；为了增加学习趣味性，增加了最新的网络信息和流行的机械类专业杂志的内容。内容的选择既考虑了专业知识的常见性，又兼顾专业英语教学过程与基础英语的过渡，选用语言地道、形式多样但不涉及过于繁杂和深奥理论的文献。通过学习本教材，读者可掌握通过多种渠道（包括专业学术期刊，硕士、博士论文，机械类全英文报刊，机械产品广告，通过网络视频和文字发布的最新科研成果，与机械设计制造相关的新闻报道等等）扩展专业英语知识的方法，十分适合在现今发达的网络和数字化信息平台下获取新的专业英语知识。

本教材分为六章，每一章围绕一个主题展开，第一章介绍本专业，第二章介绍机械设计制造史，第三章介绍如何阅读及理解专业文献，第四章介绍随时随地学习专业英语，第五章介绍实验中的英语，第六章介绍以多种方式使用专业英语。其中第三章可以从学习阅读及理解专业文献的角度，以章节形式进行；也可以从传统的机械设计制造领域分类的角度，以 TOPIC 形式进行。这将给使用本教材的教师提供多种可选择的教学方案，并通过课后练习的方式，引导教师、学生及使用本教材自学的读者学习如何阅读及理解英文专业文献，形成并发展自己的方法，可以达到“授人以渔”的效果。

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前　言

随着国际化的深入和日益广泛的国内外交流与合作，我国制造业迅猛发展，政府部门对制造业越发重视，制造业人才的需求量逐年增加，急需具备良好的国际沟通能力和紧跟技术发展动向、技术敏锐力高的高级技术通才。这意味着该类人才不仅要熟悉相关领域的专业技术，并能凭借其良好的国际沟通能力，掌握前沿技术并将其应用到企业发展中。

编者在多年的机械设计制造双语专业课、机械设计制造及其自动化专业英语的教学过程中发现，在从基础英语到专业英语的教学过程中缺乏有效过渡，导致很多学生认为专业英语既艰涩又枯燥。因此，从教学实践的角度出发，编写一本内容全面、可读性强、适合课堂教学的机械设计制造技术方面的专业英语教材十分必要。

在编撰本教材的过程中，编者有幸在美国密歇根大学访学一年。在访学过程中发现，在日常生活、课程学习和学术交流中有很多需要掌握的专业英语的表达方法。编者将这些看似简单却必要的表达方法放入本教材中，以期引起从业教师及教学教育专家的注意，达到抛砖引玉的效果。

感谢密歇根大学 S. M. Wu Manufacturing Research Center 主任倪军教授为本教材的编撰提供了优良的研究环境及丰富的学术资源。在本书编写过程中，Katherine Sholder 对全文的语法和表达进行了仔细的修订，兰州理工大学郑玉巧、吉林大学冀世军、华侨大学尤芳怡、南京航空航天大学朱栋、吉林大学张秀芝等老师对编写结构和内容给予了启发和帮助，同时赵国林、阮帆、熊飞翔等人也给予了协助，在此一并感谢。

限于时间和学术水平，本书难免存在错误及不足之处，恳请广大读者批评指正。

编　者

2017 年 9 月

目　　录

Chapter 1 Know about Your Major

1.1 An Overview of Majors/Programs in Universities All Over the World

Before we start to study this book, it is necessary to have an overview of similar majors/programs in universities all over the world. This will give you a basic understanding of why students choose this major, what students learn, and what they can do after graduation.

University

University of Limerick (UL) (Ireland)

Major

Bachelor/Master of Engineering in Mechanical Engineering

About You

This is an ideal programme for you if you are interested in solving problems using mathematics and science. If you think you might enjoy exploring areas such as mechanical design, energy systems and materials, then Mechanical Engineering at UL might be a good choice for you.

Why Study Mechanical Engineering at UL?

Mechanical Engineering at UL now offers an integrated bachelor/master of engineering programme. The entry route to both is through LM116 but in year 3 students have the choice to decide the bachelor or master of engineering programme.

- Bachelor of engineering in mechanical engineering (4 years in duration)
- Master of engineering in mechanical engineering (5 years in duration)

Mechanical engineering is a very broad-based discipline and students following the degree programme are prepared for careers in many industrial sectors, including such diverse areas as energy, chemical processing, research, manufacturing, design consultancy, material processing and aviation. The mechanical engineering degree programme aims not only to give you a thorough background in fundamental mechanical engineering subjects but also allows specialisation in one of a number of areas of particular relevance to Irish industry.

Mechanical Engineering at UL adheres to traditional guidelines set down by the professional engineering institutions (such as Engineers Ireland and IMechE) and requires you to have an aptitude for mathematics and problem solving.

Mechanical Engineering at UL is an honours degree programme accredited by Engineers Ireland (www. engineersireland. ie), and the qualifications of graduates are recognised world-wide through international accords.

Mechanical Engineering at UL now offers students the opportunity to undertake an integrated Master of Engineering programme. Student can choose this route in year 3 and will study for a further 2 years graduating with an M. E. in Mechanical Engineering. For more information, please search www. scieng. ul. ie/ schoolsdepartments/.

Course Structure

Common Entry to Biomedical, Civil, Design & Manufacture and Mechanical Engineering

The bachelor of engineering programme is of four years in duration and is divided into two parts.

Part Ⅰ

Part Ⅰ, which comprises the first year of study, provides you with a foundation in the fundamental engineering subjects and makes up for variations in the background of individual student: mathematics, computing, engineering mechanics, physical chemistry, electrical principles, fluid mechanics, production technology, the engineering profession.

Part Ⅱ

Part Ⅱ comprises years 2, 3 and 4 and you will generally study five modules per semester. You will study all the fundamental subjects of mechanical engineering—mathematics, mechanics of solids, design, mechanics of fluids, thermodynamics, dynamics of machines and control.

At the end of year 2, you are placed in industry for an eight-month cooperative education period. This period provides experience of the practice and application of mechanical engineering in an industrial environment. You will then return to the university for the latter half of the third year and start to specialise.

This programme offers a broad-based course in mechanical engineering. In addition, in the final year, you can specialise in thermofluids, mechanics of solids or energy by choosing appropriate final year electives.

An important aspect of this programme is the final year project completed in year 4. This is an individual project assigned to you at the end of year 3 giving you almost 12 months to undertake. The project is a major piece of work and involves the preparation of a report detailing all aspects of the project. It will provide you with the opportunity to demonstrate your ability to work as a professional engineer and to incorporate the knowledge you have gained over the previous three years. Many students are proud to show the work at subsequent job interviews.

For more information, please search www. scieng. ul. ie/ schoolsdepartments/.

Entry Requirements

Applicants are required to hold at the time of enrolment the established leaving certificate (or an approved equivalent) with a minimum of six subjects which must include: two H5 grades and four O6 grades or four H7 grades (H means higher level and O mean ordinary level). Subjects must include mathematics, Irish or another language and English.

In addition, applicants must hold a minimum grade H4 in mathematics and grade O6/H7 in one of the following: physics, chemistry, physics with chemistry, engineering, technology, design & communication graphics/ technical drawing, biology, agricultural science, applied maths, construction studies.

A special mathematics (higher level) examination will be offered at UL following the leaving certificate results for those students who did not achieve the mathematics requirements. We welcome applications from mature students. Mature applicants must apply through the Central Applications Office (CAO) by 1 February.

Career Prospects

Recent graduates of the programme have found jobs in the following areas.

- Automotive and manufacturing engineering
- Offshore① engineering
- Aeronautical② engineering
- Pharmaceutical③ and biomedical④ industries

① offshore [ˌɒfˈʃɔː] *adj.* 离岸的；近海的

② aeronautical [ˌeərəˈnɔːtɪkl] *adj.* 航空的；航空学的

③ pharmaceutical [ˌfɑːməˈsuːtɪkl] *adj.* 制药(学)的

④ biomedical [ˌbaɪəʊˈmedɪkl] *adj.* 生物医学的

- Optimisation and design of energy systems
- Materials and structural analysis
- Engineering consultancy
- Project management
- Control of chemical and pharmaceutical
- Bioengineering① and life sciences
- Research and development

University

University of Michigan (USA)

Major

Mechanical Engineering

Undergraduate Programs & Degrees

First year undergraduate engineering students who have not transferred from another college or university will enter the College of Engineering without declaring a specific engineering major. Students do not typically declare a major until sophomore year. College of Engineering offers 17 undergraduate programs of study that lead to a Bachelor of Science degree.

Undergraduate Program (Mechanical Engineering) Overview

Mechanical Engineering at Michigan is an undergraduate program on the move. Since 2002, They've had a boom of new faculty members and research funding, while maintaining their consistent leadership as one of U. S. News and World Report's top five ranked ME (mechanical engineering) programs in the country. Their multidisciplinary② approach to research and learning strikes a unique balance of trend-setting③ research and challenging coursework that is highly respected around the world. At Michigan, ME is assembling the finest young undergraduate talent in the country.

What's Involved in an ME Degree at the University of Michigan?

At the University of Michigan, the Bachelor of Science in Engineering degree

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① bioengineering [ˌbaɪəʊˌendʒɪˈnɪərɪŋ] *n.* 生物工程；[生物物理] 生物工程学

② multidisciplinary [mʌltidɪsəˈplɪnəri] *adj.* 有关各种学问的，包括多种学科的

③ trend-setting 创造潮流的，引领潮流的

(BSE) in ME provides students with an excellent foundation in the core technical competencies of the following disciplines: thermal and fluid sciences, solid mechanics and materials, dynamics and control. Within each of these disciplines, students will complete rigorous coursework that follows the traditional classroom format of lectures, discussions, homework, projects and exams. In addition, an array of technical electives are offered to enable students to tailor their mechanical engineering education to best suit their career goals.

During the sophomore and junior year, ME students will participate in design courses where they will work together as a team and apply the knowledge learned in their core subjects to develop a product, design and model it, and physically build it in machine shop. During their senior year, ME students will enroll in a senior capstone design course in which each team is required to complete a semester long design project developed for them by a company or researching faculty. The laboratory sequences are completed during the students' junior and senior years and involve working on a team to conduct industry-related experiments and perform data analysis. During both the design/manufacturing and laboratory courses, students are further prepared for successful careers and leadership positions by building extensive teamwork, report writings and presentation skills.

In addition to the regular BSE degree in mechanical engineering, there are numerous other programs offered to enrich education, such as dual-degrees (ME degree and a second degree from another engineering program), sequential undergraduate/graduate studies (SUGS), the engineering global leadership program (EGL), study abroad (listed on CoE minors), and independent study opportunities with ME faculty.

Students who do well in their undergraduate programs are encouraged to consider graduate work and may take some of their electives in preparation for graduate study. For more information please refer to the Graduate Handbook.

University

Massachusetts Institute of Technology

Major

Mechanical Engineering

The Educational Objectives of the Program Leading to the Degree Bachelor of Science in Mechanical Engineering

Within a few years of graduation, a majority of graduates will have completed or be progressing through top graduate programs; advancing in leadership tracks in industries, non-profit organizations, or the public sectors; or pursuing entrepreneurial ventures. In these roles they will: ① apply a wide working knowledge or technical fundamentals in areas related to mechanical, electromechanical, and thermal systems to address the needs of customers and society; ② develop innovative technologies and find solutions to engineering problems; ③ communicate effectively as members of multidisciplinary teams; ④ be sensitive to professional and societal contexts and committed to ethical actions; ⑤ lead in the conception, design, and implementation of new products, processes, service and systems.

Students are urged to contact the MechE Undergraduate Office as soon as they have decided to enter mechanical engineering so that faculty advisors may be assigned. Students, together with their faculty advisors, plan a program that best utilizes the departmental electives and the 48 units of unrestricted electives available in the Course 2 degree program. This program is accredited by the Engineering Accreditation Commission of ABET as a mechanical engineering degree.

University

Princeton University

Programs

Mechanical and aerospace engineering

Mechanical and aerospace engineers design, build and test devices and vehicles, such as cars, aircraft, satellites, engines, robots and control systems. Increasingly, electronics, computers, and mechanical devices are more and more integrated, mechanical and aerospace engineers must have a very wide knowledge and training in order to perform their jobs at the highest level. This university's program emphasis is to provide an education in the fundamentals of engineering which require the understanding and application of physical phenomena. They follow a broad system approach, where engineering decisions are made with a full appreciation of the opportunities and limitations presented by advanced technologies and their integration.

The department recognizes that students follow a variety of career paths. Some enter industries directly as practicing engineers while others continue their studies in graduate school in the fields of engineering or applied science. Others follow programs in preparation for careers in business, law or medicine. Some students enter the military. For the class of 2015, 17% of graduates decided to continue their studies in graduate school in engineering such as Cal Tech, Stanford, Yale, and Cornell. 60% chose a technical career in industries such as Ford Motor Company, Creative Edge Products, Dassault Falcon Jet, Lockheed Martin, Virgin Galactic, Facebook, Delta Airlines, SpaceX, Universal Creative, Ad Energy, Pratt and Miller, JRI-America and Telnyx. Some entered a career in the military with the U. S. Navy and the Naval Surface Warfare Center. Others began careers in management consulting, finance or environmental consulting with such companies as Boston Consulting Group, Strategy & Company, Black Rock, UBS, Oliver Wyman, Bridgewater Associates and McKinsey.

They respond to their students' varied interests by offering interdepartmental programs and topical programs. Sufficient flexibility is provided to meet a range of career objectives while providing a foundation of the engineering disciplines and associated problem solving skills.

1.2 Extended Exercise—Know about Your Knowledge of Mechanical Engineering

Please draw a mechanical engineering knowledge structure by yourself. Compare this to the previous universities' requirements and goals, and find out how excellent you are!

An example is shown in Figure 1-1.

1.3 Extended Exercise—Recognize Yourself

(1) It is generally acknowledged that most people represent information in their minds in one of three ways: as semantic information (words), as graphical information (visual images), and as analytical information (equations or relationship). Choose one of your friends in the classroom, write down the way you think he/she is good at presenting the information in Table 1-1, and write down the way you think you are good at presenting the information. What's the difference?

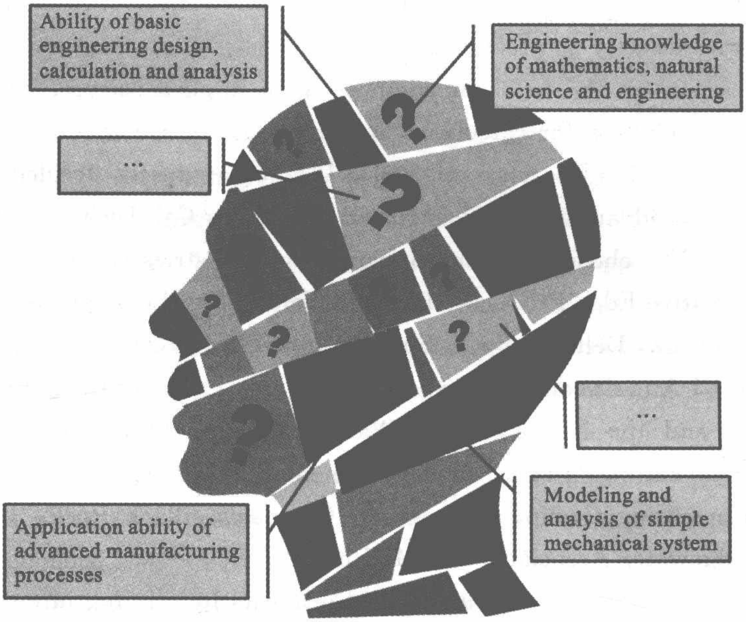

Figure 1-1 An Example of Mechanical Engineering Knowledge Structure

Table 1-1 How do You and Your Friend Present Information in Minds?

I think my friend ______________ is good at ____________________________________.	I think I am good at ______________________ ____________________________________.
1.	1.
2.	2.
3.	3.

(2) Define yourself by the poster!

There are some posters (Figure 1-2) describing engineers. Draw your own poster and describe yourself, then show it to everyone in the class!

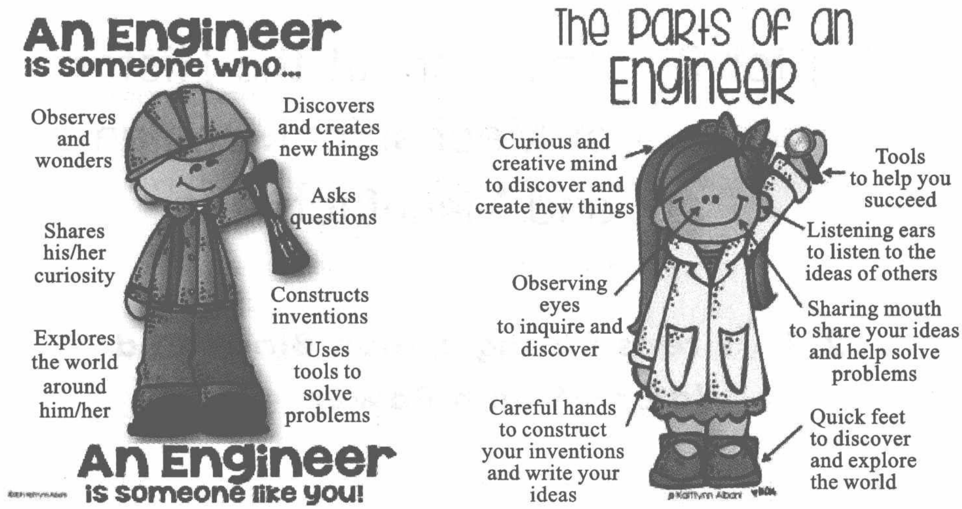

Figure 1-2 Posters Describing Engineers

Chapter 2 Know about the History of Mechanical Design and Manufacturing

2.1 Fire is Stronger than Blood and Water—Steam Power

I sell here what all men desire—Power!

Matthew Boulton (1728-1809)

Industrialist, manufacturer of steam engines

More than any other invention, more than any other device, the industrial revolution is known for the steam engine. While all of the previous developments like the manufactories or the first factories are relevant to the industrial revolutions, probably the most significant change is the development of the steam engine. The ancient Greeks were the first to mention steam-powered movements, but these were gadgets with no practical value. Only during the late seventeenth century did steam power become available. This availability of unprecedented power at almost any location changed manufacturing and the world more and faster than any other preceding developments in the history of mankind did.

Thomas Savery developed the first steam engine—or more correctly, steam pump—and patented it in 1698. The technology was still in its infant stage. There were no pistons but merely a set of valves to let steam in the chamber and water in and out of it. Hot steam was filled into a chamber and then cooled down inside it. The condensing steam created a vacuum, sucking up water through an attached pipe. This sucked-up water was then pushed upward with the inflowing steam of the next cycle. Since this engine did not create any mechanical movements but merely pumped water, it was not useable for manufacturing purposes. Additionally, due to the constant heating and cooling of the cylinder and the steam, lots of energy was wasted, and the engine worked very inefficiently. The only use of the engine was to pump up water, for which it was used with limited success to drain water out of mines. Hence, it was also advertised as a *miner's friend*. However, there were numerous problems with the engine. The engine was very inefficient, requiring expensive fuel and in need of constant maintenance. The engine was also only able to pump water from 9 meters below to about 10 meters above the engine. Hence, in order to drain[①] a mine, the engine had to be installed inside of the mine, creating lots of additional problems like providing fresh air and ventilation[②] of the exhaust. Finally, the engine also had a tendency to explode due to weak joints, and therefore, the miners might have been less excited about their new *miner's friend* deep down in the mine shafts. Overall, only 3% of all steam engines installed in Great Britain during the eighteenth century were Savery steam pumps.

A significant step forward was made by Thomas Newcomen, who, in 1712, built the first actual steam engine that converted steam into mechanical movement. The condensing steam no longer sucked up water but, rather, was sucked in a piston. While the constant heating and cooling of the cylinder still made the engine very inefficient, it was now possible to install the engine on the surface and still bring the movement through shafts and chains to the pumps inside of the mine. The engine was able to raise water up more than 30 meters. The engine worked with less steam pressure than the Savery engine and hence was unlikely to explode, surely a comforting fact to the operators of the engine. Subsequently, the Newcomen steam engines were very successful, and more than two-thirds of all engines installed in Great Britain during the eighteenth century were Newcomen steam engines. Hence, Newcomen steam engines were the first successful and widely used steam engine.

A model of the Newcomen steam engine was brought for repair to the instrument maker James Watt (Figure 2-1) in 1763. The model made only a few turns before stopping. Watt realized that the small size caused an enormous loss of energy. Hence, he started to investigate the principles of the steam engine in his spare time, realizing in 1765 that the efficiency would improve significantly if the steam didn't condense inside of the cylinder but externally in a condenser. After additional researches on how to create a better seal inside of the cylinder, Watt developed an improved and more efficient engine in 1775 (Scherer 1965)[③]. The Watt engine (Figure 2-2) used only about one-quarter of the fuel of the Newcomen

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① drain [dreɪn] *vt.* 使流出；排掉水

② ventilation [ˌventɪˈleɪʃ(ə)n] *n.* 通风设备；空气流通

③ Stating this in such few sentences makes it look obvious, but this does not give justice to Watt, who labored endlessly, calculating and researching uncountable details on the thermodynamics of steam and the principles of the steam engine, and trying out numerous technical approaches and solutions before achieving his breakthrough. Like most inventors, a great insight is usually preceded by a lot of hard work.