



21世纪高校机电类规划教材

# 工程制图

(英汉双语对照)

ENGINEERING DRAWING

胡琳 主编

 机械工业出版社  
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## ENGINEERING DRAWING

(英汉双语对照)

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机 械 工 业 出 版 社

本书是 21 世纪高校机电类规划教材。全书采用中英文对照的编排形式。在内容编排上,从工程实际出发,以应用型为主导,加强了徒手绘图和工程实际应用有关部分的讲解和相应练习,使学生通过学习,真正掌握本课程相关知识与技能。

全书共分十章,系统地介绍了工程制图基本知识、正投影基础、立体及其交线、组合体、轴测图、图样画法、常用机件的表达、零件图、装配图、计算机绘图等内容。

该套教材配套齐全,不仅有与双语教材配套的 CAI 电子教案(教师版),有对应的双语习题集,习题集中附有 CAI 练习光盘 1 张,还有习题解答和标准答案。

本书可作为高等院校理、工、经、管各专业学生“工程制图”课程(36~64 学时)的教材,或作为近机械类各专业学生“工程制图”(72~108 学时)课程的教材,也可作为高职、高专、电大、职大、函授大学、夜大等继续教育相近专业的教材,还可作为技术人员和企业管理人员的自学参考书。

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# 序

为了适应我国制造业的迅速发展的需要，培养大批素质高、应用能力与实践能力强应用综合型人才已成为当务之急。这同时对高等教育的办学理念、体制、模式、机制和人才培养等方面提出了全新的要求。

为了打通新形势下高等教育和社会需求之间的瓶颈，中国机械工业教育协会机电类学科教学委员会和机械工业出版社联合成立了“21世纪高校机电类规划教材”编审委员会，本着“重基本理论、基本概念，淡化过程推导，突出工程应用”的原则，组织教材编写工作，并力求使本套教材突出以下特点：

(1) 科学定位。本套教材主要面向应用的综合型人才的培养，既不同于培养研究型人才的教材，也不同于一般应用型本科的教材；在保持高学术水准的基础上，突出工程应用，强调创新思维。

(2) 品种齐全。这套教材设有“力学”、“制图”、“设计”、“数控”、“控制”、“实训”、“材料”“双语”等模块，方便学校选用。

(3) 立体化程度高。教材均要求配备CAI课件和相关的教辅材料，并在网站上为本套教材开设研讨专栏。

机械工业出版社是我国成立最早、规模最大的科技出版社之一，是国家级优秀出版社，是国家高等教育的教材出版基地之一，在机电类教材出版领域具有很高的地位。相信这套教材在中国机械工业教育协会机电类学科委员会和机械工业出版社的精心组织下，通过全国几十所学校的老师的仔细认真的编写，一定能够为我国高等教育应用综合型人才的培养提供更好用、更实用的教材。

教育部·机械工程及自动化专业分教学指导委员会·主任  
中国机械工业教育协会·高等学校机械工程及自动化学科教学委员会·主任  
李培根 院士  
于华中科技大学

# Preface

Manufacturing technology is advancing rapidly in our country, so it's imperative to cultivate high-qualified application-oriented talents to meet the uptodate needs, which requires the new development in the higher education mode and system.

For filling in the widening gap between social needs and status quo of higher education, the Auditing and Editing Committee for "21st Century Textbooks for Higher Education in Mechanical and Electrical Engineering" is set up by Machinery-electronics Teaching Committee subordinate to China Machinery Education Association and China Machine Press to lay out a series of practical textbooks, based on the principle of "attaching more importance to basic theories and engineering application than the process of concluding."

Features of series are as followed:

(1) Scientific objective. The series is targeted for training all-round application-oriented talents distinguished from other high-school teaching materials. It has high technicality emphasizes on engineering application and initiative innovation.

(2) Selective categories. The series includes mechanics, cartography, design, numerical control, practical training, materials, bilinguai teaching, etc. for teachers to choose.

(3) Multimedia teaching. Each volume of the series has related courseware and accessorial books and a discussion room on net.

China Machine Press, one of the early-founded, large-scale publishing houses and high-education textbooks bases, is a prestigious authority in publishing books in mechanical and electrical engineering. With concerted efforts from all circles the series of books will contribute greatly to bringing up all-developed high-qualified people for our country.

**Director/Chief of Machinery-electronics Teaching Committee, China Machinery Education  
Association  
Peigen Li, Academician  
HuaZhong University of Science and Technology**

# 前 言

当前,我国的高等教育进入了新一轮的改革阶段:大力开展基础课、专业基础课和专业课的双语教学,加速推进我国高等教育的国际化和培养高素质创造性应用型人才。因此,双语教学是我国高等教育与国际接轨,迎接新世纪挑战和教育改革发展的必然趋势,也是中国高等教育在21世纪必须作出的战略选择。本教材的编写为双语教学创造了一个良好的条件,及时地满足了高等教育与国际接轨这一教育改革形势发展的需要。

本书是依照高等学校工科制图课程教学指导委员会制订的“画法几何及工程制图课程教学基本要求”,结合近年来工程图学课程教学改革的特点编写而成的,立足培养面向21世纪的高级工程应用型人才。它面向现代制造技术,并紧紧围绕以“学”为中心、以“素质提高”为目的的指导思想,力求简明扼要、质量上乘、覆盖面广。本教材适合于高等院校为理、工、经、管各专业学生开设的“工程制图”课程(36~64学时)使用,也可用于为近机械类各专业学生开设的“工程制图”课程(72~108学时),还可作为继续教育同类专业的教材,亦可供企业的设计人员和工程技术人员作为自学参考书。

本教材针对基础课程的特点,继承传统内容的精华,融入编者多年积累的教学经验,着眼于新时期对人才培养的要求,以加强对学生综合素质及创新能力的培养为出发点,力求在不增加教师和学生负担的前提下,充分利用有限的教学资源,最大限度地调动学生的学习主动性和积极性,从而使“工程图学”教育从以“知识、技能”为主的教育向以“知识、技能、方法、能力、素质”综合培养的教育转化。本教材具有如下特点:

1. 采用中、英文对照编排形式,充分体现高等教育面向21世纪教学内容和课程体系改革的成果,立足与国际接轨高级应用型人才培养的特点,重视基本工程素质教育。
2. 以实用为主导,突出实用性和先进性。删减了图解法的内容,重点突出了与工程应用密切相关的投影基本理论、形体的表达方法及工程图样的阅读等内容,提供了典型例题及分析和解决问题的思路和方法,重视方法、能力、技能等综合能力素质的培养。
3. 强调徒手绘图的基本功训练,精心设计的习题集保证了恰当的徒手画图练习和足够的基本功训练,并注意正确处理徒手绘图、仪器绘图和计算机绘图三者之间的关系,注重对科学、严格、认真、求实的作风及工程知识、技能等应用能力素质的培养。
4. 全书采用了最新颁布的《技术制图》和《机械制图》的国家标准,根据需要选择并分别编排在正文或附录中,以培养学生贯彻最新国家标准的意识和查阅国家标准的能力。

5. 增加了 AutoCAD 绘图的内容, 根据目前国内院校的实际情况, 将计算机绘图内容集中放在第十章, 主要以学生自学为主。

6. 本教材有与之配套的 CAI 多媒体电子教案(胡琳、程蓉等编)同时出版, 该电子教案覆盖教材的全部内容, 充分运用各种软件的功能, 采用大量反映实物模型的动画演示, 形象生动、逼真, 启发性强, 可大大激发学生的学习兴趣。

该电子教案采用较易掌握的 Powerpoint 工具软件编制, 为开放式课件。其最大的好处是: 可由任课教师根据课程需要及教学习惯, 方便地自行增加、删减或重组有关内容, 或按自己的风格和特色进行改编, 以满足个性化教学的要求。

7. 在与该教材配套的《工程制图习题集》(胡琳、程蓉主编)中附有一张练习光盘。在练习光盘中有相应的立体模型动画演示等, 便于学生自学或课外辅导, 帮助学生掌握学习内容。另有一套光盘配有习题解答和标准答案, 请与出版社联系索取。练习题型博采众长, 由浅入深, 覆盖面宽, 难度适宜, 兼顾典型性和通用性, 为培养学生的空间想象力、形体构思、创造和设计能力提供了保证, 可使学生反复练习和巩固所学知识。

本书由胡琳教授任主编, 程蓉、张明莉、付苓副教授任副主编。参加本书编写的有: 深圳大学胡琳、程蓉(前言、绪论、第七章、第八章、第九章、附录), 北华航天工业学院张明莉、于海平(第一章、第二章、第四章)江汉大学付苓(第三章、第五章), 华南理工大学王枫红、孙炜(第六章、第十章)。另外, 深圳大学 2001 级学生陈稳娟参加了部分零件图、装配图、附录插图及习题集的绘图工作。

本书由教育部工程图学教学指导委员会副主任委员、广东省工程图学学会理事长、华南理工大学的陈锦昌教授(中文)和香港城市大学的马维银教授(英文)担任主审, 二位主审对书稿进行了仔细的审阅, 提出了许多宝贵意见和非常好的建议, 在此表示衷心的感谢!

本书参考了国内外一些著述和教材, 在此向有关作者致意! 并感谢其他关心和帮助本书出版的人员。

本书得到深圳大学教材建设基金资助, 在此特别表示衷心的感谢!

由于编者水平有限, 书中难免有错误和疏漏, 敬请各位专家及广大读者批评指正。

编者



# Foreword

The higher education in China is now entering a new era of reform which encourages bilingual teaching in foundation courses, technical foundation courses and technical courses. The main objective of the reform is to promote the internationalization of higher education and to cultivate application oriented talents with creativity and quality education. The bilingual teaching is thus becoming a trend for our higher education to interface with the world and to face various challenges of the new century. The reform in bilingual teaching is a strategic choice for our higher education in the twenty-first century. The introduction of this book provides a solid base for bilingual teaching and meets the immediate needs of our higher education reform for interfacing with the world.

This book was written following the *Basic Requirements in Teaching Descriptive Geometry and Engineering Drawing Course* developed by the Engineering Drawing Advisory Committee for Higher Engineering Education. It is introduced based on the current practices and needs of education reform in teaching engineering drawings. It targets for fostering application oriented talents for the twenty-first century. The development of the book is guided by advanced manufacturing technologies. It is focused on center learning activities and aims at quality education. The contents of the book cover selected topics simplified and extracted for a wide range of readers. The book is suited for an Engineering Drawing course (36 to 64 teaching hours) in universities and colleges majoring in various subjects, such as science, engineering, economy and management. It can also be used as a text book on Engineering Drawing for students whose major is closely related to mechanical engineering (72 to 108 teaching hours). It can also be used as a text book for continuing education or other equivalent programs. It is also a very good reference book for engineering designers, mechanical and manufacturing engineers.

The book was written based on the characteristics of foundation courses. It inherits the essence of a traditional drawing course and integrates extensive teaching experiences of the authors of the past years. It focuses on the education needs of the new era in fostering talents with comprehensive quality education and creative thinking. At the same time, the book strives to use the limited teaching resources to motivate students' learning while not adding extra loading to lecturers. As a result, it contributes to important changes for an "Engineering Graphics" course from a kind of "knowledge and technology transferring education" to comprehensive education focusing on knowledge, technology, methodology, capability and quality. The book has the following characteristics:

1. The bilingual edition represents the outcomes of higher education reform in teaching materials and curriculum development for the 21<sup>st</sup> century. It emphasizes on the training of application oriented talents with international views and quality education in basic engineering subjects.

2. This book is targeted for practical applications with a particular emphasis on the applicability and advancement of the subject. It simplified the contents on descriptive geometry, but emphasizes on topics closely related to practical engineering applications, such as the basic projection theory, representation of shapes and bodies, and the ability in reading engineering drawings. It also enhanced contents on case studies, analysis and problem solving skills. It also emphasizes on comprehensive training in the development of methodologies, capability in problem solving and quality education.

3. It emphasizes on the basic skills of hand drawing with carefully selected exercises. It provides well balanced materials on hand drawing, machine drawing and computer drawing. It also emphasizes on the training of students' scientific, rigorous, serious and fact-seeking attitude, disciplines, engineering knowledge and skills.

4. The book adopts the newly published national standards of *Technical Drawing* and *Mechanical Drawing* which are covered either in the main text or the appendices in order to train students with the consciousness and ability in using the newly published national standards.

5. Added the contents of AutoCAD assisted drawing in Chapter 10 to encourage students to learn by themselves.

6. The accompanied CAI multimedia with case-based teaching material edited by Ms. Hu and Ms. Cheng is published at the same time and covers the complete content of the book. The multimedia version uses a large number of engineering models, animations, and various functions of multimedia presentation for intuitive presentation of live examples and for stimulating students' learning interests.

The electric CAI multimedia version prepared using Powerpoint is an open course material with a big benefit that it could be easily modified by teachers to meet the needs of their teaching.

7. There is also a CD in the accompany EXERCISE WORKBOOK OF ENGINEERING DRAWING book edited by Ms. Hu and Ms. Cheng. The CD includes related solid models for demonstration. It covers various simple and complex questions that are suited for a wide range of students. Please come down on another CD with standard answers from publishing company.

This book is edited by Ms. Lin Hu as editor in chief and Ms. Rong Cheng, Ms. Mingli Zhang, Ms. Qin Fu as associate editors in chief. The participants as follows: Lin Hu and Rong Cheng (forward, exordium, chapter 7, chapter 8, chapter 9 and appendix); Mingli Zhang and Haiping Yu (chapter 1, chapter 2 and chapter 4); Qin Fu (chapter 3 and chapter 5); Feng-

hong Wang and Wei Sun (chapter 6 and chapter 10). In addition, Wenjuan Chen, an undergraduate from Shenzhen University, was also involved in the production of the drawings.

The book is audited by Mr. Jinchang Chen (Chinese), professor of South China University of Technology and Vice Chairman member of the Engineering Drawing Advisory Committee of the Ministry of Education and Mr. Weiyin Ma (English) of City University of Hong Kong who provided a through review and gave many invaluable suggestions which are sincerely appreciated.

The book was written with reference to some books and teaching materials and their authors are highly appreciated. Thanks also go to many others who helped in the course of the publication of this book.

Special support from Shenzhen University through a Teaching Material Development Grant is gratefully acknowledged.

Due to various limitations, this book may contain mistakes and all critics and corrections from all experts and readers are welcome.

**Authors**

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信息反馈表

# Introduction

## 1. Subjects and features of this course

Engineering Drawing is an application oriented subject that introduces the preparation, representation and reading of engineering drawings. Similar to characters and numbers, it is one of the tools used by human for the expression, conception, analysis and communication of technical information. Considering scientific and technological level, engineering drawing is an important document in industry for design, manufacture, utilization and service, often called “the common technical language for engineers”. Engineering Drawing is not only a foundation subject for a specific major, but also a part in the entire spectrum of engineering education. It also provides theories and methodologies for all engineering talents to express their spatial and visual imagination.

The course mainly studies the basic theories and methods for the preparation and reading of engineering drawings as well as related national standards on *Mechanical Drawing* and *Technical Drawing*. The main features of the book are the following:

(1) It is a foundation subject for other engineering-related subjects and education and provides a basis for studying other subjects afterwards.

(2) It is a cross disciplinary subject that integrates geometry, projection theory, basic engineering knowledge, basic engineering specifications and standards, and advanced drawing techniques.

(3) It is an engineering subject which has a close connection with body and shape construction, analysis and representation and requires continuous integration with engineering regulations and methodologies.

(4) It is a widely used practical subject integrating both theoretical and engineering practices.

(5) It provides a method covering engineering and visual imagination that could effectively train students with the ability in comprehensive spatial imagination and analysis.

(6) It is a common engineering language applicable to different regions, different disciplines, different languages, and whether for the past, present or the future. The representation of engineering drawings is always the same.

## 2. Nature and tasks of this course

Engineering Drawing is the study for the representation and communication of products and

processes. It is a carrier of engineering and product information and the communication language in engineering and industry. The course is based on rigorous theoretical and highly practical materials that are important to train students with scientific thinking and innovation. It is an important technical foundation undergraduate course for general higher education in universities and colleges.

The tasks of this course are as following:

(1) To study the basic theory and applications of orthographic projection and train students with abilities in design and innovation.

(2) To train students with a balanced skill in hand drawing, instrument drawing and computer assisted drawing as well as the ability in reading mechanical drawings.

(3) To train students with abilities in spatial and logical thinking, visual imagination, conceptualization, exploration and innovation.

(4) To train students with serious working attitude, meticulous working style and their persistence in complying with related national standards.

### 3. Aims and topics of this course

This course has four major aims and topics:

(1) Equip students with basic theory and methodologies and the ability of projection and spatial imagination.

(2) Equip students with the ability to correctly, completely, clearly and reasonably represent parts and components.

(3) Equip students with the ability in producing skilled and qualified drawings meeting related standards.

(4) Equip students with the ability in identifying and reading related national standards and proficiency in reading engineering drawings.

The study of the above topics enables students to develop their skills and ability in spatial imagination, representation, and preparation and reading of engineering drawings. It can also help establish a solid foundation for future studies of technical subjects and produce a new generation of engineering talents with strong spatial imagination and creativity.

### 4. Study methodologies of this course

The course consists of projection theory and engineering practices. Different methodologies may be applied when studying different parts of this course.

(1) When studying the projection theory, one should understand the basic concepts and basic rules. It should integrate projection analysis and geometry drawing techniques with their spatial imagination, logic reasoning and analytics judgment and establish the corresponding re-



lationship between plane drawing and spatial shape. To improve one's spatial imagination is a step-by-step process and requires repeated studies from spatial shapes to planar representations and vice versa.

(2) When studying the representation of parts and components, one should master the theory and methodologies of shape and body analysis and line and plane analysis through attending lectures or self-learning. One should be skilled in simplifying complicated problems such that the problem could be solved with minimum effort. One should also ensure careful observation, profound thinking, persistent trying and exercises and thus continuously improve his/her ability in spatial analysis and conceptualization.

(3) When studying drawing techniques, attention should be paid to proper usage of tools and mastery of methods and skills in hand drawing. All drawings must comply with related national standards. Skilled drawing using AutoCAD requires comprehensive exercise on computers and practice. Further attention should also be paid with added care to exploration, observation, and practice for producing a quality drawing.

(4) When learning reading drawings, one should participate in real engineering work and accumulate knowledge through practice. One should try to apply the knowledge in practice and thus develop ability in making observation, thinking, conclusion, application and skills in problem solving. In the process of drawing reading and exercises, try to learn from duplication, revision, exploration and creative thinking. One must be able to complete this subject through typical examples and continued synthesis of exercises and practices.

Above all, one can master and consolidate the knowledge of this course through the integration of learning and practice, carefulness and seriousness, step-by-step learning approach and correct completion of related exercises in a timely manner.