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新编电气与电子信息类本科规划教材

电子与通信专业英语

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内 容 简 介

本书共分四个部分 18 个单元。课文部分的选材以电子、通信技术的最新发展与应用为背景，内容包括数字信号处理、图像处理、高清晰度电视、模式识别、集成电路设计、宽带接入、光纤通信、3G 移动通信、宽带卫星、SDH 等，重点介绍基本概念、原理、方法与应用。实践部分内容包括：科技文献检索、撰写科技论文和英语口头报告。课文编排有丰富的教学指导内容和习题，书后附有详细的习题解答和参考译文。

本书为电子信息工程和通信工程专业本科生教学用书，并适用于相近专业的本（专）科学生或具有一定英语基础，对电子与通信工程专业英语感兴趣的读者，也可用做培训教材和自学参考书。

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前　言

专业英语这门课程是大学英语教学的一个重要组成部分，它可促进学生从学习英语知识到实际应用英语知识的提高，同时为在高年级专业课学习中使用英语教科书或参考书打下良好基础。在科学技术飞速发展的今天，不仅要求学生在校学习期间具有扎实的英语基础，还要求具有较强的专业英语综合能力。专业英语的教学侧重培养学生的专业文献阅读能力、科技英语写作能力及专业语言交流能力，它是连接大学英语与双语教学的桥梁，三者互为补充。为此，各高校在“重视基础、强调实践、扩大专业知识面、压缩不必要学时数”的总的课程调整原则指导下，力求增加双语课在专业课教学中的比重，使课程教学体系逐步与国际接轨。

本书遵循“重视基础、强调应用、突出实践”的编写原则，课文主要节选自原版英文书籍或期刊杂志，力图选择内容新、实践性强的材料，以提高学生的学习兴趣，丰富他们专业领域的新知识。全书分四部分，共 18 个单元。第一部分为数学及电子学基础部分。第二、三部分内容涉及电子信息工程与通信工程领域的各个研究方向，侧重建立新概念，传授新知识。电子信息工程领域涉及数字信号处理、图像处理、高清晰度电视、统计模式识别与集成电路设计等，通信工程领域包括数字传输、宽带接入、光纤通信、3G 移动通信、宽带卫星通信和 SDH 等，基本覆盖了电子与通信专业的各个主要方面，使学生能够掌握本专业最基本的英文词汇，为将来的学习及研究工作打下良好的基础。各单元由课文（包括词汇表、难句注释）、精选的科技英语语法知识、习题及阅读材料组成，较好地解决了学生在学习过程中，因专业应用知识欠缺、科技文体不熟、语法特点了解不深入、专业词汇量不够所带来的各种学习困难，为后续专业双语课的学习扫除障碍。第四部分为实践部分，作为面向应用型人才培养方向对专业英语教材改革的新尝试，它也是本书的一个亮点，专题讲授科技文献检索、科技论文写作及英语口头报告等实用专业英语，强调学为所用，以期达到调动学生学习专业英语的积极性的目的。

“拓宽基础、淡化专业”是当前各高校课程改革的基本思路，考虑到电子信息工程与通信工程为相近专业，在教学内容安排上也可不按专业严格区分，采取内容各有所侧重的交叉教学方式，扩展学生的专业知识面。

按统编教材教学大纲要求，本书可满足多数高校教学计划内 45~60 学时的教学计划安排，考虑到各高校教学计划不尽相同，可根据不同学时数适当选取教学内容。例如，按 45 学时教学计划安排，电子信息工程专业可选：第一部分 10 学时，第二部分 18 学时，第三部分 7 学时，第四部分 10 学时；通信工程专业可选：第一部分 6 学时，第二部分 9 学时，第三部分 20 学时，第 4 部分 10 学时。

本书是电子信息工程与通信工程专业英语教学用书，适用对象为已经顺利完成基础阶段英语学习的大学本（专）科生。该书也适用于相近专业的本（专）科学生或具有一定英语基础，对电子与通信工程专业英语感兴趣的读者，可用做培训教材和自学参考书。

本书由多年担任专业英语和专业双语课教学的教师执笔编写。第一、二部分及第 18 单元

由李霞编写，第三部分及第16、17单元由杨英杰编写，李霞对第三部分各单元课后语法知识及语法练习（练习4）进行了补充，并担任全书的统稿工作。

本书在编写过程中得到深圳大学信息工程学院和东北电力学院（大学）信息工程学院的大力支持，在此表示衷心的感谢。限于作者水平，书中不妥之处在所难免，敬请广大师生批评指正。

本教材的编写得到了深圳大学教材出版基金的资助。

编　者

2005年4月

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目　录

Part I Fundamentals

Unit 1

Text

Preface to Modern Engineering Mathematics

1.1 Modern Developments and the Teaching of Maths to Engineers

Developments in computer technology and related software have provided the engineer with tools of increasing power and sophistication which have significant implications for the use and role of mathematics in engineering practice[1]. In particular, it has led to greater use of mathematical modelling and simulation as the basis for the analysis and design of engineering systems, thus providing a more flexible and economic approach to the traditional methods which relied heavily on costly experimentation and the building of scaled models. Clearly such developments, particularly those in computer algebra or symbolic manipulation packages, also have important implications for the teaching of mathematics on engineering degree courses. To the inexperienced it is tempting to believe that the use of packaged software solves all the problems of analysis that an engineer is likely to meet and thus eliminates the need for engineering students to study mathematics. On the contrary, to the experienced engineer, the dangers of using packaged software as 'black box' solution generators are well understood yet cannot be overstressed. *If engineers are to take full advantage of sophisticated computational tools then it is essential that they become effective at mathematical modelling and discriminating, intelligent and wary users of packaged software and other aids to computational modelling*[2]. The need for mathematical skills is, therefore, greater than ever but it is widely recognized that, as a consequence of these computer related developments, there is a need for a shift in emphasis in the teaching of mathematics to students studying engineering. This shift is away from the simple mastery of solution techniques and towards development of a greater understanding of mathematical ideas and processes together with efficiency in applying this understanding to the formulation and analysis of mathematical models of physical phenomena and engineering systems. However, it is recognized that the development of understanding and the mastery of solution techniques are not mutually exclusive objectives. *There is little doubt that a high degree of fluency in the manipulation of mathematical expressions will always be required, for without this there can be no real understanding*[3]. The challenge to the teacher is that of achieving the correct balance in the mathematics curriculum.

1.2 Skills Development and Learning by Doing

The objective of the authoring team in writing this book is to achieve a balance between the development of understanding and the mastery of solution techniques with the emphasis being on the development of students' ability to use mathematics with understanding to solve engineering problems.

Worked examples

Consequently, this book is not a collection of recipes and techniques designed to teach students to solve routine exercises, nor is mathematical rigour introduced for its own sake[4]. It contains over 350 worked examples, many of which incorporate mathematical models and are designed both to provide relevance and to reinforce the role of mathematics in various branches of engineering.

Applications

To provide further exposure to the use of mathematical practice, each chapter contains sections on engineering applications. These sections form an ideal framework for individual, or group, case study assignments leading to a written report and/or oral presentation; thereby helping to develop the skills of mathematical modelling necessary to prepare for the more open-ended modelling exercises at a later stage of the course.

Exercises

There are numerous exercise sections throughout the text and at the end of each chapter there is a comprehensive set of review exercises. While many of the exercise problems are designed to develop skills in mathematical techniques, others are designed to develop understanding and to encourage learning by doing, and some are of an open-ended nature. This book contains over 1000 exercises and answers to all the questions are given. It is hoped that this provision, together with the large number of worked examples and style of presentation, also makes the book suitable for private or directed study.

Numerical methods

Recognizing the increasing use of numerical methods in engineering practice, which often complement the use of analytical methods in analysis and design and are of ultimate relevance when solving complex engineering problems, there is wide agreement that they should be integrated within the mathematics curriculum. Consequently the treatment of numerical methods is integrated with the analytical work throughout the book. Algorithms are written in pseudocode and are, therefore, readily transferable to any specific programming language by the user.

1.3 Content

The range of material covered in the book is regarded as appropriate for a first level core studies course in mathematics for undergraduate courses in all engineering disciplines. The choice of material also reflects the proposals contained in the report *A Core Curriculum in Mathematics for the European Engineer* published by The European Society for Engineering Education (SEFI) in 1992. Whilst designed primarily for use by engineering students it is believed that the book is also highly suitable for students of the physical sciences and applied mathematics. Material appropriate for second level undergraduate core studies, or possibly elective studies for some engineering disciplines, is contained in the companion text *Advanced Modern Engineering Mathematics. As a* *result of the widening of access opportunities, particularly in the United Kingdom, there is increasing heterogeneity in background knowledge in mathematics of students entering degree courses in engineering*[5].

Chapter 1 deals with numbers, algebra and functions and includes sections on topics, such as trigonometric, exponential and logarithmic functions, a knowledge of which has traditionally been assumed on entry to an engineering degree course. To most students such sections will provide a review of material with which they already have some familiarity. The remainder of the chapter develops the material further and includes sections on computer arithmetic and numerical evaluation of functions.

Chapter 2 extends the number system to include complex numbers which have important applications in engineering. Vector and matrix techniques provide the framework for much of the developments in modern engineering and so the engineer needs to have a good understanding of the foundations of vector and linear algebra. Consequently **Chapters 3 and 4** are devoted to these topics with the material being further developed in the companion text. With the increasing importance of software engineering and use of expert systems, discrete mathematics is receiving prominence, with importance in many branches of engineering. While it may not be necessary for all engineers to have a deep understanding of discrete mathematics it is believed essential that they should all have a familiarity and ease with the relevant notations and formalism; this therefore is the main objective of **Chapter 5**.

Chapter 6 provides a basic introduction to the ideas of sequences, series and limits, as essential prerequisites for the study of the calculus, which remains a powerful mathematical tool for use in solving engineering problems.

Chapters 7 and 8 are devoted to the calculus of functions of one variable and, recognizing again the mixed background knowledge in mathematics of the students, the basic ideas and techniques of differentiation and integration are reviewed in Chapter 7.

Chapter 9 extends the calculus to the case of functions of more than one variable.

Chapters 10 and 11 relate to ordinary differential equations which are representative mathematical models of practical problems in various branches of engineering. Fourier series analysis is central to many applications in engineering, such as the analysis and design of oscillatory and nonlinear systems.

Chapter 12 provides a brief introduction to this topic appropriate for first level study, with a more detailed treatment being given in the companion text. Engineering is a discipline founded upon experiment, and engineers need to know how to process their experimental data and how to assess the results of others' experiments. The aim of statistics is to extract useful information from the data. The book concludes with **Chapter 13** which illustrates how data may be plotted to good effect, and then goes on to cover the essential probability theory necessary to take account of uncertainty in engineering.

1.4 Acknowledgements

It is a pleasure to acknowledge individuals who have contributed to the development of the

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book, in particular Nigel Steele of Coventry University, who is a member of the authoring team of the companion text, John Berry of the Polytechnic of the South West, for his contribution at the outset, and to the many reviewers for giving up their valuable time to contribute comments and suggestions during the preparation of the manuscript. The authoring team have been fortunate in having a superb production team at Addison-Wesley that has given every form of assistance throughout the preparation period. The team wish to thank all those concerned and in particular the development director, Sarah Mallen, for her continued enthusiasm and support and to Susan Keany for her diligence and patience as production editor.

Words & Expressions

Algebra	['ældʒibrə]	*n.*	代数学
algorithm	['ælgəriðəm]	*n.*	算法
arithmetic	[ə'riθmətik]	*n.*	算术
calculus	['kælkjuləs]	*n.*	微积分
curriculum	[kə'rikjuləm]	*n.*	课程
differentiation	[ˌdifəˌrenʃi'eiʃən]	*n.*	微分
discipline	['disiplin]	*n.*	学科
discrete	[dis'kri:t]	*adj.*	离散的
equation	[i'kweiʃən]	*n.*	方程式；等式
evaluation	[iˌvælju'eiʃən]	*n.*	赋值；值的计算
exponential	[ˌekspəu'nenʃəl]	*adj.*	指数的，幂数的
formalism	['fɔ:məlizəm]	*n.*	形式
heterogeneity	[ˌhetərəudʒi'ni:iti]	*n.*	异种，异质，不同成分
integration	[ˌinti'greiʃən]	*n.*	积分
limit	['limit]	*n.*	极限
linear	['liniə]	*adj.*	线性的（nonlinear，非线性的）
logarithmic	[ˌlɔgə'riθmik]	*adj.*	对数的
matrix	['meitriks]	*n.*	矩阵
oscillatory	['ɔsileitəri]	*adj.*	振荡的；变动的
sequence	['si:kwəns]	*n.*	序列
statistics	[stə'tistiks]	*n.*	统计；统计学
trigonometric	[trigənə'metrik]	*adj.*	三角学的；三角法的
variable	['vɛəriəbl]	*n.*	变量
vector	['vektə]	*n.*	矢量，向量
Expert system			专家系统
Fourier series			傅里叶级数
Oral presentation			口头报告
Ordinary Differential Equation			常微分方程 (*abbr.* ODE)

Notes

[1] Developments in computer technology and related software have provided the engineer with tools of increasing power and sophistication which have significant implications for the use and role of mathematics in engineering practice. 本句中 which 引导的定语从句修饰整个主句，have implication for…表示“暗示”。

计算机技术及其相关软件的发展为工程技术人员提供了功能强大且日趋完善的工具，使数学应用于工程实践并发挥着重要作用。

[2] If engineers are to take full advantage of sophisticated computational tools then it is essential that they become effective at mathematical modelling and discriminating, intelligent and wary users of packaged software and other aids to computational modelling. 由 that 引导的主语从句（it 是形式主语）中 become 做谓语，后接两个并列成分 effective at…和…users of …，其中 discriminating, intelligent 及 wary 均修饰 users。

如想充分利用这些复杂的计算工具，工程技术人员必须熟悉数学建模，能区别各种软件包及其他计算建模辅助工具，并能灵活运用。

[3] There is little doubt that a high degree of fluency in the manipulation of mathematical expressions will always be required, for without this there can be no real understanding. 本句中 for 表示原因，manipulation 原义为“操纵、控制”，这里转译为“运用”。

毫无疑问，学生必须熟练运用数学公式，否则就不可能有真正意义上的理解。

[4] Consequently, this book is not a collection of recipes and techniques designed to teach students to solve routine exercises, nor is mathematical rigour introduced for its own sake. 本句中 not (neither)...nor...，表示“既不……也不……”，for one's own sake 作“为了它自己的好处”解。

因此，本书既不是教授学生解题方法与技巧的汇总，也未以数学本身所要求的严谨方式编写。

[5] As a result of the widening of access opportunities, particularly in the United Kingdom, there is increasing heterogeneity in background knowledge in mathematics of students entering degree courses in engineering. 本句中 access 原意“通路，访问，入门”，heterogeneity 原意“异种，异质，不同成分”，翻译时难度较大，需要在充分理解的基础上意译。

由于入学机会增多，修读工程类学位课程学生的数学基础愈见参差不齐，尤以英国为甚。

Grammar

科技英语的语法特点

科技英语作为一种揭示客观外部世界的本质和规律的信息传递工具，具有准确、简明扼要和客观正式等特点。科技文章文体的特点是：语言简练、结构严谨、逻辑性强、原理概念清楚、重点突出、段落章节分明。具体而言，科技英语在用词、语法结构及表达方式上有其自身的特点，下面分别予以介绍。

1. 词汇

（1）大量使用专业词汇和半专业词汇，例如 calculus（微积分学），bandwidth（带宽），flip-flop

（触发器）等是专业词汇，而 series, work 等是半专业词汇，在不同的学科领域含义有所不同，例如series 可作“级数”（数学）解，也可作“串联”（电学）解。

（2）大量使用词缀和词根，例如，外语教学与研究出版社出版的《英汉双解信息技术词典》中以 tele-构成的单词有 30 个。

（3）较多使用缩略词，常见的如 PCM(pulse-coded modulation，脉冲编码调制), CDMA(code division multiple access，码分多址), DSP(digital signal processing，数字信号处理)等。

（4）词性变换多，例如 sound 一词做名词时，常译为“声音、语音”，做动词时，常译为“听起来”，做形容词时，以“合理的，健全的”较为多见。

2. 词法

（1）常用一般现在时态，表示真理或客观规律的陈述。

[例 1] Vector and matrix techniques *provide* the framework for much of the developments in modern engineering.

矢量和矩阵方法为现代工程学的发展提供了框架。

（2）广泛使用被动语态，强调所论述的客观事物。

[例 2] Chapters 7 and 8 *are devoted to* the calculus of functions of one variable and, recognizing again the mixed background knowledge in mathematics of the students, the basic ideas and techniques of differentiation and integration *are reviewed* in Chapter 7.

第 7 章和第 8 章讨论单变量函数的微积分，考虑到学生数学基础参差不齐，第 7 章复习微分与积分的基本概念与方法。

（3）普遍使用名词词组及名词化结构，强调客观存在的事实而非某一行为，故常使用表示动作或状态的抽象名词。

[例 3] Television is *the transmission and reception of* images of moving objects by radio waves.

电视通过无线电波发射和接收移动物体的图像。

（4）使用非限定动词，使句子简明。

[例 4] The calculus, *aided* by analytic geometry, proved *to be* astonishingly powerful and capable of *attacking* hosts of problems that had been baffling and quite unassailable in earlier days.

微积分辅以解析几何是一个非常强大的工具，能够解决许多困扰已久甚至以前认为无法解决的问题。

3. 句法

（1）较常使用“无生命主语+及物动词+宾语（+宾语补足语）”句型。

[例 5] Chapter 6 *provides* a basic introduction to the ideas of sequences, series and limits.

第 6 章介绍序列、级数及极限等基本概念。

（2）常用 it 做形式主语或形式宾语。

[例 6] *It* has been proved that induced voltage causes a current to flow in opposition to the force producing it.

已经证明，感应电压使电流的方向与产生电流的磁场力方向相反。

[例 7] The invention of radio has made *it* possible for mankind to communicate with each other over a long distance.

无线电的发明使人类有可能进行远距离通信。

（3）尽量用紧缩型状语从句而不用完整句。

[例 8] While *designed* primarily for use by engineering students, it is believed that the book is also highly suitable for students of the physical sciences and applied mathematics.

尽管本书主要为工科学生所用，我们相信，它也非常适合于修读物理与应用数学的学生。

（4）割裂修饰比较普遍（包括短语或从句被分隔）。

[例 9] It is hoped that this *provision*, together with the large number of worked examples and style of presentation, also *makes* the book suitable for private or directed study. (主谓分离)

希望这些练习，以及书中提供的大量实例及本书的写作风格也使本书适于自学和课堂教学。

（5）较多使用祈使语气。

[例 10] *Let* the forward-pass transfer function be given by the linear difference equation.

设前向传递函数由线性差分方程给出。

（6）句中并列成分（各种并列短语、单词或从句）较多。

[例 11] Radar has certain inherent advantages over detection systems employing light waves: (1) it has greater range, (2) it is usable in any weather and in day or night, and (3) the electronic circuitry and components for *transmitting, receiving, amplifying, detecting and measuring* are highly developed.

与光波检测系统相比，雷达具有如下优点：（1）检测范围广；（2）可全天候使用；（3）拥有先进的电子元器件与电子线路，可用于信号的发射、接收、放大、检测和测量。

（7）复杂长句多。科学技术要阐明事物之间错综复杂的关系，因而需要用复杂的语法关系来表达严密复杂的思维。长句所表达的科技内容严密性、准确性和逻辑性较强。

[例 12] Recognizing the increasing use of numerical methods in engineering practice, which often complement the use of analytical methods in analysis and design and are of ultimate relevance when solving complex engineering problems, there is wide agreement that they should be integrated within the mathematics curriculum. 本句是一个主从复合句，主句为 there is...，由 that 引导同位语从句对 agreement 进行补充说明；现在分词短语 recognizing...构成紧缩型状语从句表原因，which 引导的非限定性定语从句修饰 numerical methods，其谓语为两个并列的成分，该句中还嵌套了一个由 when 引导的紧缩型时间状语从句。

分析与设计过程中常用数值计算方法来弥补解析法的不足，因此在求解复杂的工程问题时数值方法往往是最为恰当的。由于认识到数值方法在工程实践中的应用日趋增长，人们普遍认为它应该被整合到数学课程中来。

Exercises

1. Choose the best answer for each of the following questions.

（1）Mathematical modelling and simulation forms the basis for the analysis and design of engineering systems as a result of ________.

a. developments in computer technology and related software

b. developments in mathematics

c. engineering mathematics

d. the large number of students to study engineering courses

(2) For an engineering student, ________.

a. there is no need to study mathematics

b. he should spend more time on the study of mathematical skills

c. it is enough to learn to use the packaged computer software

d. the main objective is to learn to use mathematics with understanding to solve engineering problem

(3) Which one of the following statements is incorrect according to the text? ________.

a. The exercises are intended to develop skills in mathematical techniques

b. Some of the exercises are open-ended modelling ones which cannot be tackled at the beginning of the course

c. The exercises are only available at the end of each chapter

d. The exercises are designed to develop understanding and encourage learning by doing

(4) Which is not the content of the book? ________

a. differentiation and integration

b. geometry

c. discrete mathematics

d. probability and statistics

(5) ________ is vital to the analysis and design of oscillatory and nonlinear systems.

a. Fourier series analysis

b. Numerical analysis

c. Simulation and modelling

d. Random process

2. Match the term in Column A with the appropriate explanation in Column B.

Column A	Column B
1. mathematical analysis	a. symbolized arithmetic
2. algebra	b. interconnection between variables
3. calculus	c. a rectangular array of numeric or algebraic quantities subject to mathematical operations
4. function	d. a statement of equality between two equal numbers or number systems
5. probability theory	e. the study of variables and their relationships
6. matrix	f. the branch of mathematics concerning points, lines, angles, surfaces and solids
7. equation	g. mathematical treatment concerned with random events
8. geometry	h. differentiation and integration

3. Translate the following sentences into Chinese.

(1) The calculus, aided by analytic geometry, proved to be astonishingly powerful and capable of attacking hosts of problems that had been baffling and quite unassailable in earlier days.

(2) Of the many remarkable mathematical discoveries made in the 17th century, unquestionably the most outstanding was the invention of calculus.

(3) A great forward stride was made in 1821, when the French mathematician Augustin Louis Cauchy developed an acceptable theory of limits, and then defined continuity, differentiability, and the definite integral in terms of the limit concept.

(4) Mathematical analysis is one of the most important divisions of higher mathematics; its main object is studying variables and their relationships.

(5) The main purpose of a natural or technical science is to establish the relationships between the variables involved in the process under consideration and to describe it mathematically.

(6) Mathematical methods lie in the foundation of physics, mechanics, engineering and other natural sciences. For all of them mathematics is a powerful theoretical and practical tool without which no scientific calculation and no engineering and technology are possible.

Reading Material

Fourier Analysis and Synthesis

Jean Baptiste Joseph Fourier (1768—1830) studied the mathematical theory of heat conduction in his major work, *The Analytic Theory of Heat*. He established the partial differential equation governing heat diffusion and solved it using an infinite series of trigonometric functions. The description of a signal in terms of elementary trigonometric functions had a profound effect on the way signals are analyzed. The Fourier method is the most extensively applied signal-processing tool. This is because the transform output leads itself to easy interpretation and manipulation, and leads to the concept of frequency analysis. Furthermore even biological systems such as the human auditory system perform some form of frequency analysis of the input signals. The applications of the Fourier transform include filtering, telecommunication, music processing, pitch modification, signal coding and signal synthesis, feature extraction for pattern identification as in speech recognition, image processing, spectral analysis in astrophysics and radar signal processing.

1. Introduction

The objective of signal transformation is to express a signal as a combination of a set of basic "building block" signals, known as the basis functions. The transform output should lead itself to convenient analysis, interpretation and manipulation. A useful consequence of transforms, such as the Fourier and the Laplace, is that differential analysis on the time domain signal become simple algebraic operations on the transformed signal. In the Fourier transform the basic building block signals are sinusoidal signals with different periods giving rise to the concept of frequency. In Fourier analysis a signal is decomposed into its constituent sinusoids, i.e., frequencies, the

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