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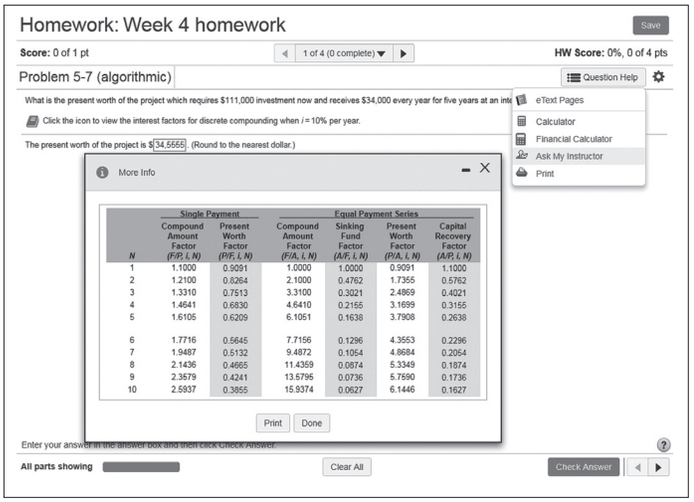

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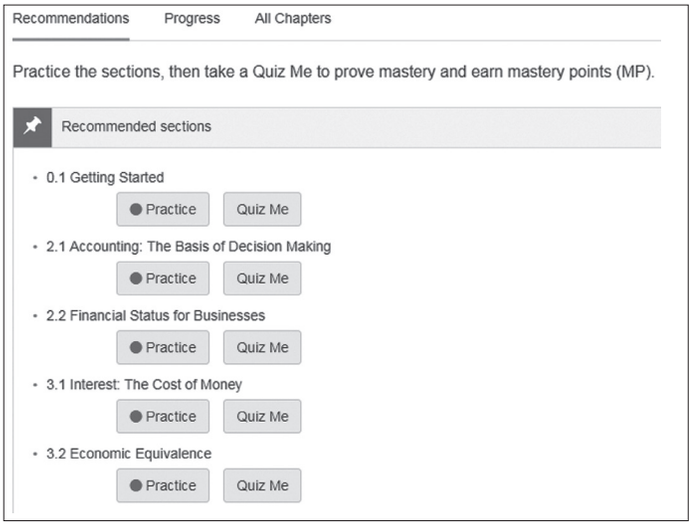

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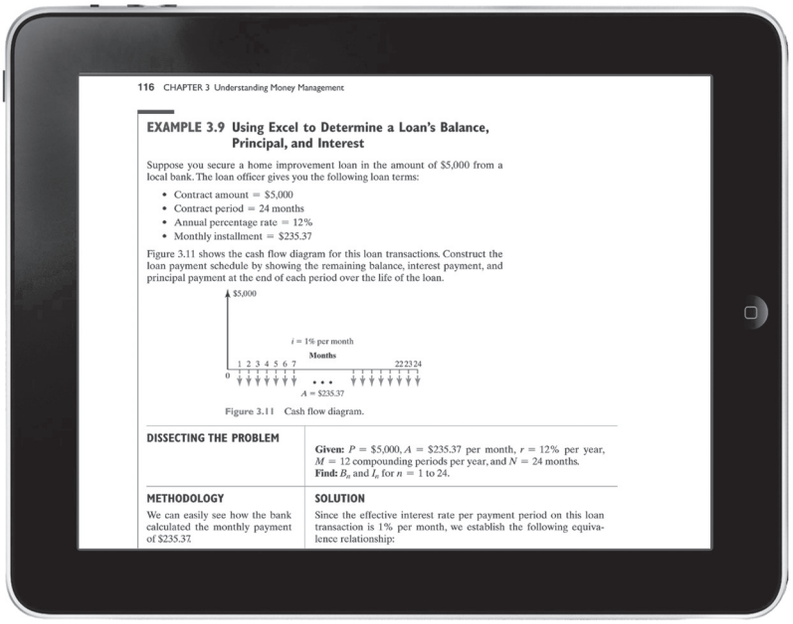

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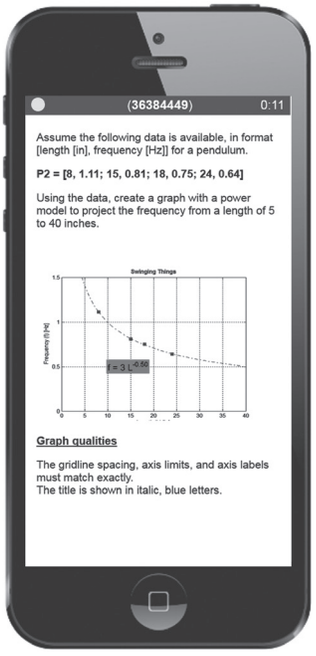

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Fundamentals of Engineering Economics

FOURTH EDITION

Fundamentals of Engineering Economics

FOURTH EDITION

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Pearson

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To Sophie, Alex, and Claire

PREFACE

Why Fundamentals of Engineering Economics?

Engineering economics is one of the most practical subject matters in the engineering curriculum, but it is an always challenging, ever-changing discipline. *Contemporary Engineering Economics* (*CEE*), now in its sixth edition, was first published in 1993, and since then, we have tried to reflect changes in the business world in each new edition along with the latest innovations in education and publishing. These changes have resulted in a better, more complete textbook, but one that is much longer than it was originally intended. This may present a problem: Today, covering the textbook in a single term is increasingly difficult. Therefore, we decided to create *Fundamentals of Engineering Economics* (*FEE*) for those who like *contemporary* but think a smaller, more concise textbook would better serve their needs.

Goals of the Text

This text aims not only to provide sound and comprehensive coverage of the concepts of engineering economics but also to address the practical concerns of engineering economics. More specifically, this text has the following goals:

1. To build a thorough understanding of the theoretical and conceptual basis upon which the practice of financial project analysis is built.
2. To satisfy the very practical needs of the engineer toward making informed financial decisions when acting as a team member or project manager for an engineering project.
3. To incorporate all critical decision-making tools—including the most contemporary, computer-oriented ones that engineers bring to the task of making informed financial decisions.
4. To appeal to the full range of engineering disciplines for which this course is often required: industrial, civil, mechanical, electrical, computer, aerospace, chemical, and manufacturing engineering as well as engineering technology.

Intended Market and Use

This text is intended for use in introductory engineering economics courses. Unlike the larger textbook (*CEE*), it is possible to cover *FEE* in a single term and perhaps even to supplement it with a few outside readings or case studies. Although the chapters in *FEE* are arranged logically, they are written in a flexible, modular format, allowing instructors to cover the material in a different sequence.

New to This Edition

Much of the content has been streamlined to provide materials in depth and to reflect the challenges in contemporary engineering economics. Some of the highlighted changes are as follows:

- All chapter opening vignettes—a trademark of *Fundamentals of Engineering Economics*—have been completely replaced with more current and thought-provoking examples from both service and manufacturing sectors.

Chapters	Chapter opening vignettes	Company	Sector	Industry
1	• A car for hire	Uber Technologies	Communications	Media, Internet-based services
2	• Powerball lottery	Personal	Consumer discretionary	Gaming
3	• College loans	Personal	Financials	Banking
4	• Baseball tickets	Boston Red Sox	Consumer discretionary	Recreational facilities
5	• Commercial building	The Endeavor Real Estate	Housing	Real estate
6	• Owning a dump truck	The City of Flagstaff	Government	Public works
7	• Value of a college degree	Personal	Consumer discretionary	Education
8	• Robot cargo handling	The Port of Los Angeles	Government	Transportation
9	• 3D Printing	Alcoa Aluminum	Materials	Metals & Mining
10	• Solar power plants	NRG Energy Co.	Utilities	Energy
11	• Pumped storage	Eagle Crest Energy	Utilities	Utility network
12	• Bio-solids fertilizer	Milorganite Factory	Private	Manufacturing
13	• Acquiring Brocade	Broadcom Company	Technology	Software

- **Self-Test Questions** have been expanded at the end of each chapter (184 problems in total), and worked-out solutions to the questions are provided in Appendix A. These questions are formatted in a style suitable for Fundamentals Engineering Exam review and were created to help students prepare for a typical class exam common to introductory engineering economic courses.

- Most of the end-of-chapter problems are revised to reflect the changes in the main text. There are 720 problems, including 184 self-test questions, 75% of which are new or updated.
- Various Excel® spreadsheet modeling techniques are introduced throughout the chapters, and the original Excel files are provided online at the Companion Website.
- Some other specific content changes made in the fourth edition are as follows:
  - In Chapter 1, updated a buy-lease decision problem, and introduced the Tesla's Gigafactory project to illustrate the scope of a large-scale engineering project.
  - In Chapter 2, updated the tuition prepayment plan and lottery examples.
  - In Chapter 3, introduced a new example to compare two different financial products.
  - In Chapter 4, updated all consumer price index (CPI) and inflation related data, restructured many examples to facilitate the understanding of equivalence calculation under inflation.
  - In Chapter 6, expanded an example of life-cycle cost analysis for an electric motor selection problem.
  - In Chapter 7, added a new section on modified internal rate of return.
  - In Chapter 8, added a new benefit–cost analysis example of comparison of mutually exclusive public projects.
  - In Chapter 9, updated any tax law changes from the 2017 Tax Cuts and Jobs Act.
  - In Chapter 10, revised a section on the tax rate to use in project analysis.
  - In Chapter 11, added a new section on the concept of value at risk (VaR) as a risk measure.
  - In Chapter 13, replaced all financial statements for Lam Research Corporation with those of J&M Corporation, and provided a new set of financial ratio analysis.
  - In Appendix A, updated all solutions to be consistent with new set of self-test questions.

Features of the Book

FEE is significantly different from *CEE*, but most of the chapters will be familiar to users of *CEE*. Although we pruned some material and clarified, updated, and otherwise improved all of the chapters, *FEE* should still be considered an alternative and streamlined version of *CEE*.

We did retain all of the pedagogical elements and supporting materials that helped make *CEE* so successful. For example:

- Each chapter opens with a real economic vignette describing how an individual decision maker or actual corporation has wrestled with the issues discussed in the chapter. These opening cases heighten students' interest by pointing out the real-world relevance and applicability of what might otherwise seem to be dry technical material.
- In working out each individual chapters example problems, students are encouraged to highlight the critical data provided by each question, isolate the question being asked, and outline the correct approach in the solution under the headings **Given, Find, Approach**, and **Comments**, respectively. This convention is employed throughout the text. This guidance is intended to stimulate student curiosity to look beyond the mechanics of problem solving to explore "what-if" issues, alternative solution methods, and the interpretation of the solutions.

- There are a large number of end-of-chapter problems and exam-type questions varying in level of difficulty; these problems thoroughly cover the book's various topics.
- Most chapters contain a section titled "Short Case Studies with Excel," enabling students to use Excel to answer a set of questions. These problems reinforce the concepts covered in the chapter and provide students an opportunity to become more proficient with the use of an electronic spreadsheet.
- Many of Excel spreadsheets now contain easy-to-follow call-out formulas. The integration of Excel is another important feature of FEE. Students have increased access to and familiarity with Excel, and instructors have more inclination either to treat these topics explicitly in the course or to encourage students to experiment independently. One could argue that the use of Excel will undermine true understanding of course concepts. This text does not promote the trivial or mindless use of Excel as a replacement for genuine understanding of and skill in applying traditional solution methods. Rather, it focuses on Excel's productivity-enhancing benefits for complex project cash flow development and analysis.

To Student: How to Prepare for the Fundamentals of Engineering (FE) Exam

The set of self-study questions at the end of each chapter is designed primarily to help you develop a working knowledge of the concepts and principles of engineering economics. However, the questions are also perfect resource to help you prepare the Fundamentals of Engineering (FE) exam. All questions are structured in multiple-choice format because these types of exam questions are used in the FE exam and, increasingly, in introductory engineering economics courses.

The FE exam typically consists of 180 multiple-choice questions. During the morning session (120 questions), all examinees take a general exam common to all disciplines. During the afternoon session (60 questions), examinees can opt to take a general exam or a discipline-specific (Chemical, Civil, Electrical, Environmental, Industrial, or Mechanical) exam.

The general exam includes four questions related to engineering economics in the morning session and five in the afternoon session. The specific engineering economics topics covered in the FE exam are

- Discounted cash flow (e.g., equivalence, PW, equivalent annual, FW, and rate of return)
- Cost (e.g., incremental, average, sunk, estimating)
- Analyses (e.g., breakeven, benefit–cost)
- Uncertainty (e.g., expected value and risk)
- Valuation and depreciation

Some sample questions are also provided by the National Council of Examiners for Engineering and Surveying (www.ncees.org/exams).

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CONTENTS