Fundamentals of Engineering Economics

THIRD EDITION

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To my mentors: James R. Buck (late),
Gerald J. Thuesen, and
Vernon E. Unger

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 fifth 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 revised or completely replaced with more current and thought-provoking examples from both service and manufacturing sectors.

Chapters	Chapter Opening Vignettes	Company	Sector	Industry
1	• Social networking	Facebook	Technology services	Internet software/Services
2	• Powerball lottery	Personal	Consumer	Gaming
3	• Credit cards	Personal	Financial	Banking
4	• Dallas Cowboys	Dallas Cowboys	Entertainment	Sports
5	• LCD glass manufacturing	Corning Glass	Manufacturing	Electronic components
6	• Owning a corporate jet	Hawker Beechcraft Corporation	Electronic technology	Aerospace/ Defense
7	• What's a degree really worth?	Personal	Consumer	Education
8	• High-speed Internet	Australian Government	Public	Computer communication
9	• Obama to propose tax write-off for business	U.S. Government	Public	Taxation
10	• Coke leveraging its investment in plant-based packaging	Coca Cola	Consumer nondurables	Beverages/ Packaging
11	• Japanese oil company looks to the rising sun	Solar Frontier KK's	Energy	Integrated oil
12	• Finding a fix for the Tappan Zee Bridge	State of New York	Public	Construction
13	• Warren Buffett	Berkshire Hathaway	Finance	Property/ Insurance

- **Self-Test Questions** have been added at the end of each chapter (131 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.

- The Benefit–Cost Analysis section has been moved to Chapter 8 as a part of measure of investment chapters. The profitability index is included in this chapter.
- Most of the end-of-chapter problems are revised to reflect the changes in the main text. There are 708 problems, including 131 self-test questions, 43% 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. Most worksheets have been redesigned with graphical outputs.
- Some other specific content changes made in the third edition are as follows:
  - In Chapter 1, a cost reduction (Apple's iPad®) project is introduced.
  - In Chapter 2, a new retirement planning example is introduced.
  - In Chapter 4, all CPI- and inflation-related data have been updated.
  - In Chapter 5, an example of comparing mutually exclusive revenue projects is provided.
  - In Chapter 6, a section on capital cost has been expanded with an automobile ownership example.
  - In Chapter 8, benefit–cost contents have been streamlined, and a new section on the profitability index has been created.
  - In Chapter 11, the section on risk-adjusted discount rate approach is expanded in which the risk element is incorporated through the cost of capital.
  - In Chapter 13, all financial statements for Lam Research Corporation have been updated, and a new set of financial ratio analysis is provided. Investment strategies have been added as a part of managing personal financial asset under uncertainty.

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.
- All 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).

Companion Book Website

A Companion Website **(www.pearsonhighered.com/park)** has been created and maintained by the publisher. This text takes advantage of the Internet as a tool that has become increasingly important in accessing a variety of information. The website contains a variety of resources for both instructors and students, including various online

financial calculators. As you type the address and click the open button, you will see the *Fundamentals of Engineering Economics* home page. There are three main links on the Companion Website:

- *Instructor Resources:* This is a password-protected link for registered instructors where the Instructor's Manual and PowerPoint slides for lecture notes can be found. A comprehensive *Instructor's Manual* in Word® format includes answers to end-of-chapter problems and Excel® solutions to all complex problems.
- *Student Resources:* This is where students can access online financial tools such as (1) Interest Factor Tables, (2) Cash Flow Analyzer, (3) Depreciation Analysis, and (4) Loan Analysis. The **Cash Flow Analyzer** is an integrated computer software package written in Java®. The software includes the most frequently used methods of economic analysis. It is menu-driven for convenience and flexibility, and it provides (1) a flexible and easy-to-use cash flow editor for data input and modifications and (2) an extensive array of computational modules and user-selected graphic outputs.
- *Author's Resource Website:* This content has been created and maintained by the author and contains several pieces of information useful in conducting engineering economic analyses.
  - *Tax Information:* This section will serve as a clearinghouse for disseminating ever-changing tax information, personal as well as corporate. Links are provided to various tax sites on the Web, so you will find the most up-to-date information on depreciation schedules as well as capital gains taxes.
  - *Money and Investing:* This section provides a gateway to a variety of information useful in conducting engineering economic analysis. For example, a direct link is provided to the most up-to-date stock prices, options, and mutual fund performances.
  - *Economic Tracks:* This section includes cost and price information as well as the most recent interest rate trends. In particular, the consumer price indices, productivity figures, and employment cost indices are some of the representative economic data provided.
  - *Financial News:* This section provides access to various financial news outlets on the Web. The site divides news outlets into online news and daily, weekly, and monthly publications.

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