Fundamentals of Engineering Thermodynamics

9th Edition

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Preface

A Textbook for the 21st Century

In the 21st century, engineering thermodynamics plays a central role in developing improved ways to provide and use energy, while mitigating the serious human health and environmental consequences accompanying energy—including air and water pollution and global climate change. Applications in bioengineering, biomedical systems, and nanotechnology also continue to emerge. This book provides the tools needed by specialists working in all such fields. For non-specialists, this book provides background for making decisions about technology related to thermodynamics—on the job and as informed citizens.

Engineers in the 21st century need a solid set of analytical and problem-solving skills as the foundation for tackling important societal issues relating to engineering thermodynamics. The ninth edition develops these skills and significantly expands our coverage of their applications to provide

- current context for the study of thermodynamic principles.
- relevant background to make the subject meaningful for meeting the challenges of the decades ahead.
- significant material related to existing technologies in light of new challenges.

In the ninth edition, we build on the **core features** that have made the text the global leader in engineering thermodynamics education. We are known for our clear and concise explanations grounded in the fundamentals, pioneering pedagogy for effective learning, and relevant, up-to-date applications. Through the creativity and experience of our author team, and based on excellent feedback from instructors and students, we continue to enhance what has become the leading text in the field.

New in the Ninth Edition

The ninth edition features a **crisp new interior design** aimed at helping students

- better understand and apply the subject matter, and
- fully appreciate the relevance of the topics to engineering practice and to society.

Other Core Features

This edition also provides, under the heading How to Use This Book Effectively, an updated roadmap to core features of this text that make it so effective for student learning. To fully understand all of the many features we have built into the book, be sure to see this important element.

In this edition, several enhancements to improve student learning have been introduced or upgraded:

- The *p–h* diagrams for two refrigerants: CO_2 (R-744) and R-410A are included as Figs. A-10 and A-11, respectively, in the appendix. The ability to locate states on property diagrams is an important skill that is used selectively in end-of-chapter problems.
- **Animations** are offered at key subject matter locations to improve student learning. When viewing the animations, students will develop deeper understanding by visualizing key processes and phenomena.
- Special text elements feature important illustrations of engineering thermodynamics applied to our environment, society, and world:
  - **Energy & Environment** presentations explore topics related to energy resource use and environmental issues in engineering.
  - **BioConnections** discussions tie textbook topics to contemporary applications in biomedicine and bioengineering.
  - **Horizons** features have been included that link subject matter to thought-provoking 21st-century issues and emerging technologies.

Suggestions for additional reading and sources for topical content presented in these elements provided on request.

- End-of-chapter problems in each of the four modes: **conceptual, checking understanding, skill building, and design** have been extensively revised.
- New and revised class-tested material contributes to student learning and instructor effectiveness:
  - Significant content explores how thermodynamics contributes to meet the challenges of the 21st century.
  - Key aspects of fundamentals and applications within the text have been enhanced.
- In response to instructor and student needs, class-tested changes that contribute to a more **just-in-time** presentation have been introduced:
  - **TAKE NOTE...** entries in the margins are expanded throughout the textbook to improve student learning. For example, see Section 1.2.3.
  - **Boxed material** allows students and instructors to explore topics in greater depth. For example, see Section 3.5.2.
  - **Margin terms** throughout aid in navigating subject matter.

Supplements

The following supplements are available with the text:

- Outstanding *Instructor* and *Student* companion web sites (visit www.wiley.com/college/moran) that greatly enhance teaching and learning:
  - Instructor Companion Site: Assists instructors in delivering an effective course with resources including
    - a Steam Table Process Overview to assist students in mastering the use of the steam tables for retrieving data.
    - animations—with just-in-time labels in the margins.
    - a complete solution manual that is easy to navigate.
    - solutions to computer-based problems for use with both *IT: Interactive Thermodynamics* as well as *EES: Engineering Equation Solver*.
    - image galleries with text images available in various helpful electronic formats.
    - sample syllabi on semester and quarter bases.
    - correlation guides to ease transition between editions of this text and for switching to this edition from another book.
  - Student Companion Site: Helps students learn the subject matter with resources including
    - Steam Table Process Overview.
    - animations.
    - answers to selected problems.
  - *Interactive Thermodynamics: IT software* is a highly valuable learning tool that allows students to develop engineering models, perform "what-if" analyses, and examine principles in more detail to enhance their learning. Brief tutorials of *IT* are included within the text and the use of *IT* is illustrated within selected solved examples.
  - Skillful use of tables and property diagrams is prerequisite for the effective use of software to retrieve thermodynamic property data. The latest version of *IT* provides data for CO_2 (R-744) and R-410A using as its source Mini REFPROP by permission of the National Institute of Standards and Technology (NIST).
  - *WileyPLUS* is an online set of instructional, practice, and course management resources. Included for students are the complete digital textbook with embedded links for question assistance, problems for Checking Understanding that provide immediate feedback, and Checking Understanding and Developing Engineering Skills problems for self-testing and practice. Course management resources for instructors include the ability to track student progress and provide feedback, automatic grading functions, and algorithmic functionality for the problems so they can be used for practice or for testing/grading.

Visit www.wiley.com/college/moran or contact your local Wiley representative for information on the above-mentioned supplements.

Ways to Meet Different Course Needs

In recognition of the evolving nature of engineering curricula, and in particular of the diverse ways engineering thermodynamics is presented, the text is structured to meet a variety of course needs. The following table illustrates several possible uses of the textbook assuming a semester basis (3 credits). Courses could be taught using this textbook to engineering students with appropriate background beginning in their second year of study.

Type of course	Intended audience	Chapter coverage
Survey courses	Nonmajors	• Principles. Chaps. 1–6. • Applications. Selected topics from Chaps. 8–10 (omit compressible flow in Chap. 9).
	Majors	• Principles. Chaps. 1–6. • Applications. Same as above plus selected topics from Chaps. 12 and 13.
Two-course sequences	Majors	• First course. Chaps. 1–7. (Chap. 7 may be deferred to second course or omitted.) • Second course. Selected topics from Chaps. 8–14 to meet particular course needs.

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We continue to be extremely gratified by the reception this book has enjoyed over the years. With this edition we have made the text more effective for teaching the subject of engineering thermodynamics and have greatly enhanced the relevance of the subject matter for students who will shape the 21st century. As always, we welcome your comments, criticisms, and suggestions.

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