

Manufacturing Engineering and Technology

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EDITION

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Dedicated to our families, whose patience and
support made this book possible.

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Preface



Since the mid-2000s, manufacturing has undergone a rebirth in its development and research activities. With the recognition that manufacturing adds value to products, and wealth to national economies, governments around the world have been investing in their infrastructure and are now partnering with industry to bring new manufacturing capabilities to the global marketplace.

Manufacturing continues to be a dynamic activity, providing all-encompassing opportunities for contributions from several traditional disciplines. The proliferation of powerful software and Internet communication tools, especially their wireless capabilities, has made new approaches possible. The engineering terminology now includes such terms as Big Data, mass customization, cobots, and cybersecurity. Traditional manufacturing approaches and the materials involved are constantly being adjusted for ever-increasing efficiency and continuous improvements in performance.

In view of the advances being made in all aspects of manufacturing, the authors have continued their efforts to present a comprehensive, balanced, and, most importantly, an up-to-date coverage of the science, engineering, and technology of manufacturing. As in its previous editions, this text maintains the same number of chapters, while continuing to emphasize the interdisciplinary nature of all manufacturing activities, including complex interactions among materials, design, and manufacturing processes and operations.

Every attempt has been made to motivate and challenge students to understand and develop an appreciation of the vital importance of manufacturing in the modern global economy. The extensive questions and problems, at the end of each chapter, are designed to encourage students to explore viable solutions to a wide variety of challenges, giving them an opportunity to describe and assess the capabilities as well as limitations of all manufacturing processes and operations. These challenges include economic considerations and the competitive aspects in a global marketplace. The numerous examples and case studies throughout the book also help give students a perspective on real-world applications of the topics described throughout the book.

What's New in This Edition

- This new 8th edition was developed as a Pearson eText and is filled with content and tools that help bring the course content to life. Pearson eText is a simple-to-use, mobile-optimized, personalized reading experience. It lets students add bookmarks, highlight, and take notes all in one place, even when offline. Instructors can customize the content to fit the way they teach their course and even share notes and resources with students directly through the eText. A loose-leaf print upgrade is available to students to purchase within the eText.
- The text has been thoroughly updated, with numerous new topics and illustrations relevant to all aspects of manufacturing. See the table on Page xxiv for specifics.
- Wherever appropriate, illustrations and examples have been replaced, indicating recent advances in manufacturing.
- The text contains more cross references to other relevant sections, tables, and illustrations in the book.
- The Questions, Qualitative Problems, Quantitative Problems, and Design/Projects at the end of each chapter have been expanded.
- The Bibliographies at the end of each chapter have been thoroughly *updated*.

- A Solutions Manual, available for use by instructors, has been expanded; it now provides MATLAB code for numerous problems, allowing instructors to easily be able change relevant parameters.
- Reflecting the rapid advances in additive manufacturing, Chapter 20 has been thoroughly revised to include the latest technologies.

New or expanded topics in this edition are:

Chapter	Topics
Introduction	Complexity of products; definition of Technology Readiness Level and Manufacturing Readiness Level, to show the stages in product development and manufacturing at scale; case study on three-dimensional printing of guitars; expansion and update of the section on Trends in Manufacturing.
1	ISO for grain size number.
5	Second- and third-generation high-strength steels; nano-structured steels; and new case study on high-strength steels in automobiles.
6	Addition of the Hall-Héarley process for aluminum manufacture; new sections on lithium and rare earth metals; a case study on Tesla automobile design and manufacture; metamaterials.
7	Electrically conductive and semi-conductive polymers; gels and aerogels.
8	Porous ceramics; graphene; carbon and graphite foam.
10	Freeze casting.
11	Integrated computational materials engineering (ICME); machining of sand molds; new case study on a die-cast magnesium liftgate.
13	Tailor-rolled blanks and tailored coils.
15	Friction stir extrusion.
16	Expansion of hot stamping of sheet metal; camera-based forming-limit diagrams; electrically assisted forming; new case study on single-point incremental forming.
17	Expansion of powder morphology effects.
20	Additive Manufacturing: mass customization; distributed manufacturing; composite AM; projection stereolithography; continuous liquid interface production (CLIPS); new case study on AM of athletic shoes; powder bed processes; JetFusion; wire and arc AM; bioprinting; architectural applications of AM; conformal cooling; expanded section on design for AM; topology optimization; economic considerations; new case study on the implications of powder reuse.
23-24	Design considerations in machining; new case study on machining aerospace parts from monolithic aluminum.
25	Stability lobes in chatter.
26	Engineered abrasives; new case study on gear grinding with engineered abrasives.
27	Electrolytic trepanning; shaped-tube electrolytic machining.
28	Roll-to-roll printing; flexible electronics; conductive and semi-conductive inks; rotogravure, flexography, flat and rotary screen printing; self-aligned imprint lithography; flexible hybrid electronics; new case study on a flexible Arduino.
29	Photonic integrated circuits; mesoscale manufacturing.
31	Friction stir spot welding; expansion of linear friction welding.
37	Microcontrollers; cloud computing; cybersecurity; gain scheduling; cobot; design considerations.
38	Cloud storage; expansion of ERP and MES.
39	Mass customization; Internet of Things; cloud computing; MTConnect; Big Data; digital twin.
40	Life-cycle engineering; energy use in manufacturing.

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