Preface

Objectives

This text is intended for students beginning the study of mechanical engineering design. The focus is on blending fundamental development of concepts with practical specification of components. Students of this text should find that it inherently directs them into familiarity with both the basis for decisions and the standards of industrial components. For this reason, as students transition to practicing engineers, they will find that this text is indispensable as a reference text. The objectives of the text are to:

- Cover the basics of machine design, including the design process, engineering mechanics and materials, failure prevention under static and variable loading, and characteristics of the principal types of mechanical elements
- Offer a practical approach to the subject through a wide range of real-world applications and examples
- Encourage readers to link design and analysis
- Encourage readers to link fundamental concepts with practical component specification.

New to This Edition

Enhancements and modifications to the ninth edition are described in the following summaries:

- *New and revised end-of-chapter problems.* This edition includes 1017 end-of-chapter problems, a 43 percent increase from the previous edition. Of these problems, 671 are new or revised, providing a fresh slate of problems that do not have years of previous circulation. Particular attention has been given to adding problems that provide more practice with the fundamental concepts. With an eye toward both the instructor and the students, the problems assist in the process of acquiring knowledge and practice. Multiple problems with variations are available for the basic concepts, allowing for extra practice and for a rotation of similar problems between semesters.
- *Problems linked across multiple chapters.* To assist in demonstrating the linkage of topics between chapters, a series of multichapter linked problems is introduced. Table 1–1 on p. 24 provides a guide to these problems. Instructors are encouraged to select several of these linked problem series each semester to use in homework assignments that continue to build upon the background knowledge gained in previous assignments. Some problems directly build upon the results of previous problems, which can either be provided by the instructor or by the students' results from working the previous problems. Other problems simply build upon the back-

ground context of previous problems. In all cases, the students are encouraged to see the connectivity of a whole process. By the time a student has worked through a series of linked problems, a substantial analysis has been achieved, addressing such things as deflection, stress, static failure, dynamic failure, and multiple component selection. Since it comes one assignment at a time, it is no more daunting than regular homework assignments. Many of the linked problems blend very nicely with the transmission case study developed throughout the book, and detailed in Chap. 18.

- *Content changes.* The bulk of the content changes in this edition falls into categories of pedagogy and keeping current. These changes include improved examples, clarified presentations, improved notations, and updated references. A detailed list of content changes is available on the resource website, www.mhhe.com/shigley.

  A few content changes warrant particular mention for the benefit of instructors familiar with previous editions.

  - Transverse shear stress is covered in greater depth (Sec. 3–11 and Ex. 3–7).
  - The sections on strain energy and Castigliano's method are modified in presentation of equations and examples, particularly in the deflections of curved members (Secs. 4–7 through 4–9).
  - The coverage of shock and impact loading is mathematically simplified by using an energy approach (Sec. 4–17).
  - The variable σ_{rev} is introduced to denote a completely reversed stress, avoiding confusion with σ_a, which is the amplitude of alternating stress about a mean stress (Sec. 6–8).
  - The method for determining notch sensitivity for shear loading is modified to be more consistent with currently available data (Sec. 6–10).
  - For tension-loaded bolts, the yielding factor of safety is defined and distinguished from the load factor (Sec. 8–9).
  - The presentation of fatigue loading of bolted joints now handles general fluctuating stresses, treating repeated loading as a special case (Sec. 8–11).
  - The notation for bearing life now distinguishes more clearly and consistently between life in revolutions versus life in hours (Sec. 11–3).
  - The material on tapered roller bearings is generalized to emphasize the concepts and processes, and to be less dependent on specific manufacturer's terminology (Sec. 11–9).

- *Streamlining for clarity to the student.* There is a fine line between being comprehensive and being cumbersome and confusing. It is a continual process to refine and maintain focus on the needs of the student. This text is first and foremost an educational tool for the initial presentation of its topics to the developing engineering student. Accordingly, the presentation has been examined with attentiveness to how the beginning student would likely understand it. Also recognizing that this text is a valued reference for practicing engineers, the authors have endeavored to keep the presentation complete, accurate, properly referenced, and straightforward.

Rationale for Non-Conversion to SI Units

In some cases the U.S. customary units have been retained in this SI edition. The reasons are as follows:

- Trade/brand products commonly used in the industry adopt U.S. customary units. Examples and problems based on these products will therefore not have the units converted to SI. Examples of these can be found in Chapter 8.
- The variable diametral pitch (see page 676) is only used with U.S. customary units. Some examples found in Chapters 13 and 14, as well as Case Study Part 3 in Chapter18, are not converted to SI units because they are based on diametral pitch.
- Empirical expressions like the AGMA equations (see Chapter 15) were derived from research done based on products in U.S. customary units. Examples that use these equations are not converted to SI units.

Supplements

Instructor Supplements (provided to instructors using this SI edition)

- *Solutions manual*. The solutions manual contains solutions to most end-of-chapter nondesign problems.
- *PowerPoint slides*. Slides of important figures and tables from the text are provided in PowerPoint format for use in lectures.

The following are related to users of the U.S. edition.

www.mhhe.com/shigley

- *Tutorials—Presentation of major concepts, with visuals*. Among the topics covered are pressure vessel design, press and shrink fits, contact stresses, and design for static failure.
- *MATLAB® for machine design*. Includes visual simulations and accompanying source code. The simulations are linked to examples and problems in the text and demonstrate the ways computational software can be used in mechanical design and analysis.
- *Fundamentals of Engineering (FE) exam questions for machine design*. Interactive problems and solutions serve as effective, self-testing problems as well as excellent preparation for the FE exam.
- *C.O.S.M.O.S.* A complete online solutions manual organization system that allows instructors to create custom homework, quizzes, and tests using end-of-chapter problems from the text.

Connect Engineering

The ninth edition also features McGraw-Hill Connect Engineering, a Web-based assignment and assessment platform that allows instructors to deliver assignments, quizzes, and tests easily online. Students can practice important skills at their own pace and on their own schedule.

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