pear as 72 inches in the calculations. This slows the learning process, because the student has to solve a series of these little distractions. The second general complaint involves incorrect use of terms. A common practice in mechanics texts is talking about rope and pulley problems. The poor student never learns that ropes go with sheaves and pulleys are for belts. He invests in an engineering degree, yet the day after graduation, he will appear very ignorant in any basic technical discussion. Mott avoids both of these pitfalls.

In conclusion, the more practical reviewer is wildly enthusiastic about this text, because it is a student learning aid with high-quality presentation of both theory and practicality. In his opinion, it is definitely the best choice for engineering programs which aim to produce functioning engineers at the end of a baccalaureate program. The more theoretical reviewer, on the other hand, sees the book as a very nice, undistinguished text. Averaging these views results in a strong recommendation to use *Applied Strength of Materials* in all English-speaking engineering programs, except the most theoretical ones which regard the BS degree exclusively as a stepping stone to graduate school.

6R15. Machine Design: An Integrated Approach. - RL Norton *(Worcester Polytechnic Inst, Worcester MA)*. Prentice Hall, Upper Saddle River, NJ. 1996. 1048 pp. ISBN 0-13-565011-9. Includes CD ROM and Student Manual.

Reviewed by PJ Eagle (Dept of Mech Eng, Univ of Detroit - Mercy, 4001 W McNichols Rd, PO Box 19900, Detroit MI 48219-0900).

This textbook is targeted for a design of machine elements course taught to upper-division undergraduates in a mechanical engineering program. The author states that the book is intended for junior- and senior-level students, emphasizing the traditional topics of engineering mechanics and failure theory and providing thorough coverage of synthetic issues in the design of machine elements. The content is tied to an included CD-ROM of the TKSolver computer program and numerous programmed examples and case studies. Although the book makes significant reference to the TKSolver examples, this volume could be used in a stand-alone fashion or in conjunction with other software without difficulty.

The integrated approach that is advanced by this text is in contrast to the more-traditional analysis of the individual elements approach found in most texts on the same topic. The author has provided a dense set of analysis tools, standards, and examples that covers both the theoretical aspects of machine component design (stress, stain, deflection, fatigue, fracture, etc) and case studies, continually revisited in the text, illustrating design decision-making. The same case studies, carried from chapter-to-chapter, are used as a platform for introducing various analysis techniques.

The text consist of 15 chapters and several appendices that present the engineering mechanics, failure analysis, and component design (characteristics of shafts, bearings, gearing, and other hardware). Each chapter begins with a very useful list of symbols and corresponding engineering units and an introduction. A substantial number of exercises (both traditional and TKSolver-based), a table of the important equations, and a bibliography are provided in each chapter. Several chapters include exercises that are drawn from the same case study or system.

The most valuable aspect of the book is the thorough treatment of examples. Numerical results are presented in a very complete format. Unlike several other popular texts on this subject, there are examples that look at the whole system (such as a gear train), including kinematics and function, not just stress analysis. There are very good-quality, intuitive graphs for stress, strain, and deflection associated with each problem. The page format includes margin notes that provide supplemental information such as free body, shear, moment, slope, and deflection diagrams. Each analysis topic is augmented with numerous scanned images from various sources related to the technology being studied (complementary to the theory), such as surface roughness parameters and bearing nomenclature. The book offers a complete treatment of shaft, including dynamic characteristics, thereby eliminating the need to refer to dynamics or vibrations books when lecturing on this subject.

Some aspects of the text are distracting, however. Most illustrations of machine elements are presented in a format that is not standard for engineering drawing. Large arrow-heads, unclear sections, and poor dimensioning practices are exhibited in virtually every illustration. There is also an unnecessary review of statics which would probably be skipped in most classes utilizing this as a textbook. There are more thorough and technical sound treatments of some topics in competitive texts. Threaded fasteners is one such area.

The use of TKSolver is not a central feature of the text, despite the amount of attention paid to it. Although there is an overview explaining how to use this tool and numerous examples involving it, TKSolver is not tightly coupled to the text. This could be intentional in order to allow the use of other computer tools indigenous to a particular undergraduate program. Some examples that use TKSolver are unnatural and do not warrant the use of this computer tool.

In summary, this reviewer would strongly recommend *Machine Design: An Integrated Approach* as a textbook for an undergraduate course in mechanical design taught in an engineering program. This reviewer suggests that instructors currently using other texts closely examine this one as an option.

6R16. Sensors: A Comprehensive Survey. Mechanical Sensors Series, Vol 7. - HH Bau *(Dept of Mech Eng and Appl Mech, Univ of Pennsylvania, 297 Towne Bldg, 220 S 33rd St, Philadelphia PA 19104-6315)*, NF deRooij *(Inst of Microtech, Univ of Neuchatel, Rue A-L Breguet 2, CH-2000 Neuchatel, Switzerland)*, B Kloeck *(Inst of Microtech, CSEM, Rue A-L Breguet 2, CH-2000 Neuchatel, Switzerland)*. VCH Publ, New York. 1994. 674 pp. ISBN 0-89573-679-9. $285.00.

Reviewed by ML Nagurka (Carnegie Mellon Res Inst, 700 Technology Dr, PO Box 2950, Pittsburgh PA 15230-2950).

This book is Volume 7 of a handbook series on sensors. The aim of the series is to provide a comprehensive survey of sensor technology and to prepare the way for future research activities and next-generation technology developments. The series is divided into several volumes. Volume 1 addresses general aspects and fundamentals: physical principles, basic technologies, and general applications. Volumes 2 and 3 concentrate on chemical and biochemical sensors. Volume 4 treats thermal sensors. Volume 5 deals with magnetic sensors. Volume 6 addresses optical sensors. The current one, Volume 7, focuses on mechanical sensors. The series closes with Volume 8 consisting of two parts, one on trends, the other on sensor markets.

In general, each volume describes specific physical and technological fundamentals and relevant measuring parameters; types of sensors and their technologies; and important applications and discussion of emerging trends. The material in this volume follows the spirit of this classification scheme.

Mechanical sensors are devices which measure mechanical quantities such as force, torque, power, stress, displacement (translational and rotational), strain, acceleration, pressure, flow rate, density, viscosity, sound, and (nonreacting) mixture composition. The book describes a wide range of sensors that can be used for measuring these physical quantities. However, as acknowledged by the editors, the subject of mechanical sensors is too large to be covered exhaustively in a single volume. While providing a broad description of the principles of operation and practical aspects of a large number of devices, the book tends to emphasize recent developments, particularly the design and use of microfabricated sensors. However, even here, there are differences in the level of detail and depth of coverage.

The first part of the volume, Chapters 2 through 8, discusses mechanical-to-electrical conversion principles and presents de-

vices such as strain gages, capacitors, piezoresistors, Hall effect units, and thermoelectric units. The second part, Chapters 9-16, describes sensors used for the measurement of mechanical quantities such as acceleration, force, torque, density, pressure, sound, and vibration. Each chapter stands as an independent unit, and the book can readily be used as a technical reference. An extensive index, as well as a list of symbols and abbreviations are provided. However, an overall bibliography or list of sensor manufacturers is not.

The selection of an appropriate sensor requires consideration of a number of factors, including frequency response, precision, sensitivity, calibration, size, safety, reliability, durability, compatibility with the working environment, and cost. Some of these factors are discussed in the book, although significantly more attention seems warranted. This reviewer was surprised by the limited discussion of the important and challenging topic of sensor selection.

The editors are to be credited with creating a handbook that is a highly-readable, seamless production. Although the chapters are written by different contributors, the writing style seems uniform throughout. Furthermore, the book maintains strong organizational consistency, each chapter beginning with a contents section and ending with a reference section (generally quite extensive). The text is supported by a large collection of figures, schematics, and photographs of sensors, as well as basic modeling developments (to the level of differential equations). Because of its uniformity in both writing style and layout, the book could be used as a course or workshop text, except for several drawbacks, mainly that the chapters do not seem integrated with one another (ie, cross-referenced); the volume seems to lack a discussion of relative merits, comparisons of different sensor option, and guidelines for selection; and the cost is above the acceptable range for an individual. Based on price alone, the publishers have created a library reference book.

Sensors: A Comprehensive Survey is recommended as a reference source for both developers, practicing engineers, and scientists. It bridges the newest developments drawn from technical reports, published articles, and commercial sources with more-traditional presentations. For the latter, the interested reader is referred to books such as *Mechanical Measurements* by TG Bekwith and RD Marangoni (Addison-Wesley, 1990); *Control Sensors and Actuators* by CW deSilva (Prentice-Hall, 1989); and *Measurement Systems: Applications and Design* by EO Doebelin (McGraw-Hill, 1990). This reviewer would be pleased to see this volume and others in the series available in CD format.

6R17. Strength and Fracture of Engineering Solids, Second Edition. - DK Felbeck *(Univ of Michigan, Ann Arbor MI)* and AG Atkins *(Univ of Reading, UK)*. Prentice-Hall, Englewood Cliffs NJ. 1996. 535 pp. ISBN 0-13-856113-3. $78.00.

Reviewed by JB Haddow (Dept of Mech Eng, Univ of Victoria, Victoria, BC V8W 3P6, Canada).

This book contains 19 chapters and 15 appendices, covering five general areas, including a preamble, strength of ductile materials, polymers and glasses, fracture of solids, and fatigue and failure analysis. It is noted in the Preface that three new and developing subjects, mainly fundamentals and applications of high-performance composites, brittle fracture from the perspective of both the classic Griffith-Orowan-Irvin analysis and the toughness approach of Gurney, and failure analysis, are considered. The level of presentation is aimed at second- or third-year college students, one of the prerequisites being, according to the authors, a basic course in materials science. This prerequisite may not be necessary, since the treatment of materials science topics is extensive enough for an undergraduate course and is self-contained. However, a first course in mechanics of materials is a desirable prerequisite.

SI units are used throughout the book, with a brief discussion of the SI system in Chapter 1. Prefixes for SI units and factors for conversion to SI units are provided in Appendices 1 and 2, respectively.

Chapters 1 through 3 are the Preamble. In the first chapter, stress, strain, and factor of safety are defined for simple tension. A detailed treatment of the tension test and a brief mention of the combined tension and torsion, compression, and bulge tests are given in Chapter 2. This chapter includes a section on the Mohr circle diagram, along with a mixed selection of topics, such as hardness testing, mechanical processing, working loads, and anisotropy. Much of Chapter 2 could have been omitted, since most of the topics are covered in more detail in courses on mechanics of materials. Properties and applications of various alloys and composite materials are briefly discussed in Chapter 3.

The strength of ductile materials, covered in Chapters 4 through 11, is the main focus of the book. Chapter 4 is concerned with crystalline and amorphous solids, discussing crystalline and polymer structures. There is a short section on thermodynamics of solid, liquid, and vapor phases in Chapter 5, followed by crystallographic topics, such as Miller indices, slip, and dislocations. The remaining chapters, 6 through 11, present an excellent and fairly-detailed introduction to physical metallurgy. The discussion of stainless and heat-resistant steels in Chapter 11 should be useful for practicing engineers involved in the application of these materials.

Chapters 12 and 13 are mainly concerned with polymers and glasses. Creep and stress relaxation are discussed in Chapter 12, but the treatment of viscoelasticity is superficial and restricted to simple shear. Topics such as the temperature-dependent stress-strain rate behavior of certain metals, metal super plasticity, and polymer drawing are also considered. The molecular structure of polymers is introduced in Chapter 13 as a preliminary to the section on design applications. Useful experimental data on the mechanical behavior of polymers is presented graphically in this chapter.

Chapter 14 contains an elementary introduction to fracture mechanics. Crack tip plasticity is discussed; however, there is no reference to classical plasticity theory. An interesting section on brittle cracking in large structures is included in this chapter. Chapter 15 discusses the metallurgy of the various types of cast iron, and includes some historical notes on the topic. Chapter 16 is concerned with ceramics and glasses, and Chapter 17 with composites. Chapters 14 through 17 constitute the fourth general mentioned in the Preface; however, there is no close relation between the topics in Chapter 14 and those in Chapters 15 through 17.

Chapters 18 and 19 constitute the last section of the book. Chapter 18 covers fatigue and stress corrosion, including a section on hydrogen embrittlement. Chapter 19 discusses failure analysis. Different methods of examining failed parts are presented, and some interesting case studies of actual failures are provided. These studies are well-illustrated and are of considerable value for engineers involved in court cases which result from failures of structures or mechanical devices.

There are may excellent figures in the book, a good subject index, and many references. The appendices consist mainly of property tables of metallic and nonmetallic engineering materials.

This book is an excellent basis for a senior undergraduate course in civil or mechanical engineering, its suitability enhanced by numerous problems with solutions and extensive problem sets at the end of most of the chapters. It would also be very useful for practicing engineers. In particular, the case studies referred to in Chapter 19 may be of great interest to those involved in legal aspects of engineering failures. Design applications are emphasized throughout the book, setting it apart from most other materials science texts. In conclusion, it is this reviewer's opinion that *Strength and Fracture of Engineering Solids, Second Edition* is a significant contribution to the literature on the strength and fracture of engineering solids.