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Book Reviews

Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, second edition, 1991, 804 pages.

Reviewed by Ken Youssefi[1]

This book has been written primarily to introduce mechanical engineering students to the field of Machine Component Design. However, the book may also be used as a reference for practicing engineers. The book consists of two major parts. Part I (first nine chapters) is a review of strength of material topics, material properties and an introduction to static and fatigue failure theories and fracture mechanics; part II (next 10 chapters) deals with the actual design of machine components using the fundamentals covered in the first part. The machine components covered include: fasteners, springs, bearings, gears, brakes and clutches, shafts and flexible components. The last chapter is devoted to a case study and design considerations.

The book offers good theoretical background with some practical insight into the design of different components. The design procedure for each component is outlined clearly in each chapter followed with an example reflecting the authors' practical experience in that particular field. Also provided are numerous illustrations of actual components. The book has a chapter on surface damage which is not included in other books on the same subject. The chapter on welding does not include welding codes in practice; the chapter on gears should include more description of the AGMA approach and standards for gear design since it is an approach practiced widely by designers.

The second edition is essentially the same as the first edition. The main differences are: the problems have been moved to the end of the respective chapters for better continuity, more problems have been added, and examples have been improved with further illustrations.

Advances in Thermal Modeling of Electronic Components and System—Vol. 2, Avram Bar-Cohen and Allan Kraus, editors, ASME Press, 1990.

Reviewed by V. P. Carey[2]

Advances in Thermal Modeling of Electronic Components and System—Vol. 2 is the second in a biannual series which documents recent developments in analysis of the thermal control of electronics. The six chapters of this book are each written by different authors. Each of the first five chapters provides a state-of-the-art review of a different specialized area.

Chapter 1 describes recent developments related to air cooling and interconnection heat transmission in minicomputers and microcomputers. This material is covered from a designer's viewpoint, discussing the practical considerations together with strategies for optimizing the heat transfer characteristics of chip and module configurations typical of mini- and microcomputers. Heat transfer modeling is not covered in depth, but limiting cases of the performance characteristics are explored in a useful manner.

Chapter 2 is a detailed presentation of analytical methods for analyzing fin arrays in heat sinks. The discussion is limited in its extent, but it does a good job of covering methods that are particularly useful for analysis of fin arrays in component heat sinks. This chapter would provide a useful starting point for packaging designers who need to access tools for analyzing finned heat sinks.

The third chapter is a state-of-the-art review of microchannel heat sinks for electronics component cooling applications. This excellent review describes both the manufacturing methods and the heat transfer considerations associated with the use of microchannel coolant passages. A very useful summary of recent research in this area is presented in this section and analytical methods for predicting the performance of microchannel heat sinks are discussed in detail. The chapter concludes by describing the aspects of microchannel development that need further investigation.

Chapter 4 presents a review of recent research on MOS electronics and thermal control for cryogenically cooled computer systems. The low temperature characteristics of MOS electronics are first discussed, followed by a description of strategies for thermal control of components operating at cryogenic temperatures. Chapter 5 provides a summary of recent developments in direct liquid cooling of electronic components. The first portion of this chapter is qualitative, describing the design strategies and physical embodiments of direct liquid cooling of chips and other components. The latter part of the fifth chapter discusses the heat transfer mechanisms associated with direct liquid cooling. The qualitative characteristics of the mechanisms are outlined and recent improvements in predicting the heat transfer performance are summarized.

The final chapter of the book is a broad-view summary of recent research on heat transfer in electronic equipment, with an extensive bibliography. Overall, this book is a valuable source of information for electronic packaging designers or practitioners involved in electronics cooling research. It might also be a useful secondary text for a course on electronics thermal control or electronics packaging.

NC Machine Programming and Software Design, Chao-Hwa Chang and Michel A. Melankoff, Prentice Hall Inc., 1989, 589 pages.

Reviewed by Mark A. Fugelso[3]

This book is a welcome addition to the literature on numerical

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control (NC) programming because it gives a very thorough exposition of APT programming in both two and three dimensions and also it explains the inner workings of APT to a greater extent than other books. It is an advanced book on part programming, containing important material that is not available in the many introductory books that have been published on the subject in the past. This book will be of interest to manufacturing engineers, advanced part programmers, and post processor developers. There are problems at the end of the chapters that would be suitable for students in an engineering course at the senior/grad level, making this a very good engineering school text as well as a reference for practitioners. However, the book does not cover NC hardware at all.

Part one consists of chapters 1 and 2, which give a brief overview of NC technology and then describes manual NC programming, defining coordinate systems, block formats, and function codes for NC machines. Part two consists of chapters 3 thru 8, these chapters describe the APT programming language in great detail. Chapter 4 describes the geometric entities used in APT, and the explanations of the more complicated geometric definitions such as ruled surface and tabulated cylinder are very well done. Chapter 5 describes the definition of cutter contouring motion with many examples and diagrams of both 2 and 3 dimensional cutter motion. Chapter 6 describes machining specifications and miscellaneous statements such as tolerancing specifications and the tool statement. There is even a section on the effect of the cutter top surface on the cutter path, this topic is rarely covered in text books and is often the source of major programming difficulties. Chapter 7 covers loop programming, subprogramming, and coordinate system transformations. These powerful techniques are covered in detail. Chapter 8 covers the procedures for running an APT program, describing the structure and program flow thru the five major sections of APT. There are programming problems at the end of this chapter on cutting gear teeth and pump impellers.

Part three, consisting of chapters 9 and 10, covers the creation of NC Programs with CAD systems. In chapter 9 some of the mathematical methods for generating contouring motion are described. Also, some of the basic requirements for cutter motion are enumerated. Chapter 10 describes the NC capabilities of IBM's CADAM system.

Part four, chapters 11 thru 15, is about the design and implementation of postprocessors. This information is usually only available in reference manuals for specific computer systems. The APT CLFILE (center line file) is described in detail and the DAPP method of producing postprocessors is covered. This is material for specialists, but it is good to see it explained in a textbook because the computer reference manuals are terse and difficult to understand.

APT is a very mature and powerful software, and the many elementary books on APT that exist do not do justice to it. This may be the definitive book on APT.

Integrating Productivity and Quality Management, Johnson Aimie Edosomwan, Marcel Dekker, Inc., 1987.

Reviewed by Edward R. Crossman[4]

This book presents several techniques for measurement and improvement of manufacturing and service productivity, and of product quality. It will be of interest to practicing industrial (IE) and quality assurance (QA) engineers, possibly also to production and operations managers and CEOs.

Techniques reviewed in depth include capital, labor and materials productivity measurement, statistical process-control, design of experiments for process improvement, and organization of Quality-Control-Circles, here called (the) "Quality Error Removal" (technique). Topics outlined include work measurement, management development, employee motivation, job design, morale management, and management of a productivity and quality improvement program.

Practical methods are illustrated by case-study outlines on printed-circuit-board and shoe manufacturing, fast-food outlet operation, and check-processing by a "medium-sized bank."

The tone throughout is didactic, with very little discussion either of alternate approaches or of conditions under which the recommended methods are, or are not, likely to prove physically effective and/or cost effective. Only one of the many possible organizational structures is considered, with a Productivity and Quality Management (PQM) department under a Corporate VP and "plant or site program managers of productivity and quality." Since this structure is quite rare in contemporary industry, the author should at least have indicated how his recommendations might be implemented in more conventionally structured organizations. Unless, that is, his PQM department is really a conventional IE department that has absorbed the QA department or its equivalent, and changed its name, in which case both the corporate and plant-level IEs and QA engineers on the department's staff will have their own ideas and approaches to PQM problems!

Ergonomics: Harness the Power of Human Factors in Your Business, E. T. Klemmer, ed., Ablex Publishing Corp., Norwood, NJ, 1989.

Reviewed by Edward R. Crossman[5]

This is a collection of essays by senior figures in the human factors (HF) profession, all having had charge of HF or related departments in private industry. The title is somewhat misleading because, excepting a short section of Klemmer's own chapter, no space is devoted to systematic presentation of the group of scientific and engineering techniques and databases collectively known as "ergonomics." Also coverage is restricted to product design, excluding material on human performance capabilities, productivity, safety, the working environment, etc., normally considered to belong within ergonomics. The book will be mainly of interest to general and engineering managers, particularly those concerned with functional design of consumer durable products for a marketplace increasingly dominated by Japanese competition.

Of the individual chapters, perhaps the most interesting for the latter type of reader will be Wasserman's piece on "Redesigning Xerox . . ." By recounting his former firm's sudden loss of market share in the 1976–82 period, ascribed by him to relatively poor "operability" of the product, and the subsequent partial recovery, ascribed to redesign for improved operability, Wasserman makes a strong case for user-oriented and market-driven ". . . corporate-wide design strategy . . ." He illustrates the needed functional-design process with some telling early instances of the now widespread graphic and iconic approach to user/machine interfacing.

Parsons' chapter makes somewhat similar points for the strategically quite different aerospace industry, and the editor's interview with his one-time boss John Karlin, the first psychologist hired (by Bell Labs in 1945) as a civilian HF engineer, provides some very good early examples of the user-oriented design process as applied to telephone equipment then under development, but now universally accepted.

The remaining chapters all discuss strategic and organiza-

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