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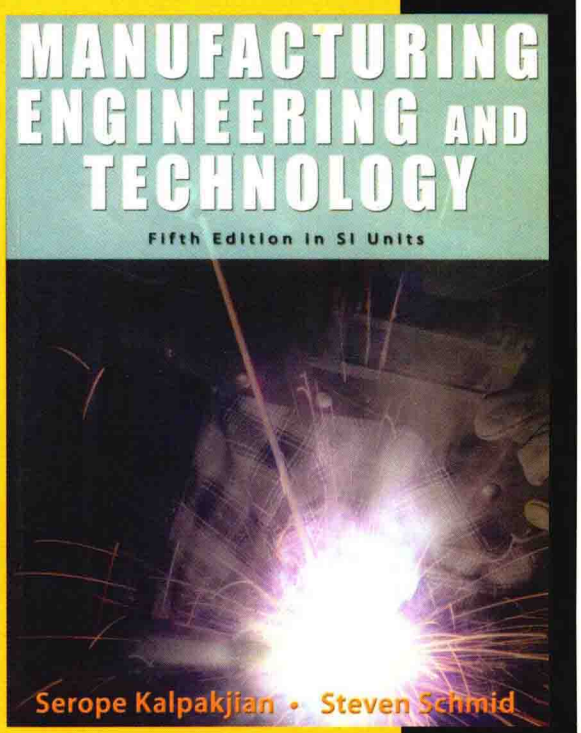
国外大学优秀教材——工业工程系列（影印版）

Serope Kalpakjian, Steven Schmid

制造工程与技术
（第5版）

Manufacturing Engineering and Technology

(Fifth Edition)



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Illinois Institute of Technology

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The University of Notre Dame

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Forward

This textbook series is published at a very opportunity time when the discipline of industrial engineering is experiencing a phenomenal growth in China academia and with its increased interests in the utilization of the concepts, methods and tools of industrial engineering in the workplace. Effective utilization of these industrial engineering approaches in the workplace should result in increased productivity, quality of work, satisfaction and profitability to the cooperation.

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Gavriel Salvendy

Department of Industrial Engineering, Tsinghua University

School of Industrial Engineering, Purdue University

April, 2002

前　言

本教材系列的出版正值中国学术界工业工程学科经历巨大发展，实际工作中对工业工程的概念、方法和工具的使用兴趣日渐浓厚之时。在实际工作中有效地应用工业工程的手段将无疑会提高生产率、工作质量、合作的满意度和效果。

该系列中的书籍对工业工程的本科生、研究生和工业界中需要解决工程系统设计、运作和管理诸方面问题的人士最为适用。

加弗瑞尔·沙尔文迪
清华大学工业工程系
普渡大学工业工程学院（美国）
2002 年 4 月

About the Authors

Serope Kalpakjian is a professor emeritus of mechanical and materials engineering at the Illinois Institute of Technology, Chicago. He is the author of *Mechanical Processing of Materials* (Van Nostrand, 1967) and a co-author of *Lubricants and Lubrication in Metalworking Operations* (Dekker, 1985). Both of the first editions of his books *Manufacturing Processes for Engineering Materials* (1984) and *Manufacturing Engineering and Technology* (1989) have received the M. Eugene Merchant Manufacturing Textbook Award. He is the author of numerous technical papers and articles in handbooks and encyclopedias, and has edited several conference proceedings. He has been editor and co-editor of various technical journals and is on the editorial board of *Encyclopedia Americana*.

Among other awards, Professor Kalpakjian has received the Forging Industry Educational and Research Foundation Best Paper Award (1966), an Excellence in Teaching Award from IIT (1970), a Centennial Medallion from the ASME (1980), the International Education Award from SME (1989), a Person of the Millennium Award from IIT (1999), and the Albert Easton White Outstanding Teacher Award from ASM International (2000). The SME Outstanding Young Manufacturing Engineer Award for 2002 was named after him. He is a Life Fellow of ASME, Fellow of SME, Fellow and Life Member of ASM International, an emeritus full member of CIRP (International Institution for Production Engineering Research), and is a founding member and past president of NAMRI/SME. He is a high-honor graduate of Robert College (Istanbul), Harvard University, and the Massachusetts Institute of Technology.

Steven R. Schmid is an Associate Professor in the Department of Aerospace and Mechanical Engineering at the University of Notre Dame, where he teaches and conducts research in the general areas of manufacturing, machine design, and tribology. He received his Bachelor's degree in Mechanical Engineering from the Illinois Institute of Technology (with Honors) and Master's and Ph.D. degrees, both in Mechanical Engineering, from Northwestern University. He has received numerous awards, including the John T. Parsons Award from the Society of Manufacturing Engineers (2000), the Newkirk Award from the American Society of Mechanical Engineers (2000), the Kaneb Center Teaching Award (2000 and 2003), and the Ruth and Joel Spira Award for Excellence in Teaching (2005). He is the recipient of a National Science Foundation CAREERS Award (1996) and an ALCOA Foundation Award (1994).

Dr. Schmid is the author of over 80 technical papers, has co-authored the texts *Fundamentals of Machine Elements, Fundamentals of Fluid Film Lubrication*, and *Manufacturing Processes for Engineering Materials*, and has contributed two chapters to the *CRC Handbook of Modern Tribology*. He serves on the Tribology Division Executive Committee of the American Society of Mechanical Engineers, is an Associate Editor of the *Journal of Manufacturing Science and Engineering*, and is a registered Professional Engineer and Certified Manufacturing Engineer.

PREFACE

The science, engineering, and technology of manufacturing processes and systems continue to advance rapidly on a global scale and with major impact on the economies of all nations. In preparing this fifth edition, our goal throughout has been to provide a comprehensive and state-of-the-art manufacturing engineering and technology textbook, with the additional aims of motivating and challenging students to study this important discipline.

As in the previous four editions, the text presents topics with a balanced coverage of relevant fundamentals and real-world practices to help the students develop an understanding of the often complex interrelationships among the many technical and economic factors involved in manufacturing.

While this new edition basically follows the same introductory nature, format, and organization as the fourth edition, it now includes increased emphasis on (a) the influence of materials and processing parameters in understanding individual processes and operations; (b) design considerations, product quality, and manufacturing costs; and (c) the global competitive context of each manufacturing process and operation, highlighted with numerous illustrative examples and case studies.

What is New in this Edition

A page-by-page comparison with the fourth edition will indicate that literally thousands of changes have been made to improve the clarity and thoroughness of the numerous topics covered.

- As a general guide for the student, each chapter now begins with a brief, highlighted outline of the chapter objectives, the topics to be described, and their relevance. Wherever appropriate, a list has been included regarding typical parts made by the processes described in the chapter and the alternative methods of producing the same parts.
- Most of the illustrations in the book have been revised thoroughly for improved graphic impact and clarity, and numerous new photographs have been added.
- There are now two chapters on the topics of microelectronic and microelectromechanical device and system manufacturing, including MEMS.
- There are about 120 examples and case studies, all highlighted.
- The questions and problems in each chapter have been updated, about 20% of which are new to this edition. Also, the last section of the questions and problems is now labeled "Synthesis, Design, and Projects" to better reflect the increased emphasis on these topics throughout the book.
- The text has more cross-references throughout to other relevant sections, chapters, tables, and figures in the book.
- The bibliographies at the end of each chapter have been thoroughly updated.

Study Aids

- Each topic is presented within a larger context of manufacturing engineering and technology, using various flowcharts and schematic diagrams whenever appropriate.

- There is a continued emphasis on the practical uses of the concepts described and information presented.
- Attempts have been made to provide analogies, discussions, and problems designed to stimulate the student's interest and curiosity about consumer and industrial products and how they are manufactured while minimizing production costs.
- Extensive data and reference materials, including numerous tables, illustrations, graphs, and bibliographies are presented.
- Several new examples and case studies have been included to highlight important concepts and techniques in manufacturing.
- Numerous tables compare advantages as well as limitations of major competitive manufacturing processes.
- A chapter summary and a list of key terms is included to help and remind students of the topics covered in the chapter.

Audience

As in the previous editions, this fifth edition has been written for students in mechanical, manufacturing, industrial, biomedical, aerospace, and metallurgical and materials engineering programs. It is hoped that by reading and studying this book, students will come to appreciate the vital nature of manufacturing engineering and technology as an academic subject that is as exciting, challenging, and important as any other discipline.

We would be grateful for any comments from instructors and students regarding any suggestions about the numerous topics presented or any errors that may have escaped our attention during the preparation of this text.

Acknowledgments

This book, together with its previous editions, represents a total of about 20 years of effort. It could not have been written and produced without the help of numerous colleagues and former students. It gives us great pleasure to acknowledge the assistance of the following in the preparation and publication of this fifth edition: K. E. McKee Illinois Institute of Technology; K. J. Weinmann, Michigan Technological University, P. J. Guichelaar, Western Michigan University, Z. Liang, Indiana University-Purdue University, Fort Wayne, and R. Abella, University of Toledo. We also acknowledge Kent M. Kalpakjian as the original author of the chapter on Fabrication of Microelectronic Devices.

We would like to thank our editors Dorothy Marrero and Eric Svendsen at Prentice Hall for their enthusiastic support and guidance, to Rose Kernan for her meticulous editorial and production supervision and the interior design of this book, and to Xiaohong Zhu for the development of all the new illustrations in the book.

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SEROPE KALPAKJIAN

STEVEN R. SCHMID

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