

A green wireframe model of a car, showing the chassis, wheels, and body panels, set against a dark background.

Third Edition

CAD/CAM

Principles and Applications

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Education

P N RAO



CAD/CAM: PRINCIPLES AND APPLICATIONS

3rd Edition

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Dr P N Rao has authored five books, beside the present one, all published by Tata McGraw Hill Education, New Delhi.

- *Numerical Control and Computer Aided Manufacturing*, 1985 (Kundra and Tewari as co-authors)
- *Manufacturing Technology: Vol. 1: Foundry, Forming and Welding*, 3rd Ed 2009
- *Computer Aided Manufacturing*, 1993 (Kundra and Tewari as co-authors)
- *AutoCAD 14 for Engineering Drawing Made Easy*, 1999
- *Manufacturing Technology: Vol. 2: Metal Cutting and Machine Tools*, 2nd Ed 2009

He is also a co-editor of *Emerging Trends in Manufacturing* (Proceedings of the 12th All India Machine Tool Design and Research Conference, 1986) published by Tata McGraw Hill Education, New Delhi.

His biographical information has appeared in *Marquis Who's Who in The World*, *Marquis Who's Who in Finance and Industry*, *Marquis Who's Who in Science and Engineering*, *Marquis Who's Who in America*, *Marquis Who's Who in American Education*, published by Reed Elsevier Inc., New Providence, USA, and *Dictionary of International Biography and Who's Who in Asia and the Pacific Nations*, published by The International Biographical Centre, Cambridge, UK.

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3rd Edition

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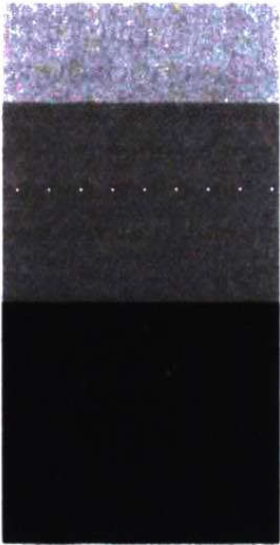
Dedication to

My elder brother

Parankusam

*who appreciated and supported the importance of knowledge
and reading throughout his life*

PREFACE



It is my pleasure to note that the earlier editions of the book have gained wide acceptance among the academic community. The second edition of this book was published in 2004. Since then, many new software like AutoCAD 2010 and Inventor 2010 have come out in the field of CAD/CAM. As it is a constantly evolving branch of learning, so the text covering this subject needs constant updation and revision. Hence, in order to be in congruence with the contemporary technological advancements plus current syllabi and competitive requirements, revision of the text had become crucial.

The original intention of this book was to provide a user viewpoint of CAD/CAM such that the application aspect is covered in greater detail. The current syllabi of most of the Indian universities have significant coverage of CAD principles as a part of their courses. Many suggestions received have alluded to this fact, and as a result these have been substantially expanded in this edition.

The modifications done in this edition are listed below:

Chapter 23 on Computer Aided Quality Control is a new chapter added with details on Inspection and testing, CMM, Non-contact inspection, SQC, SPC, TQM, Six Sigma, Integration of CAQC.

Chapter 3 Additional details on data models, engineering data management system, expanded coverage of clipping methods, hidden surface algorithms, and colour and shading procedures

Chapter 4 Expanded coverage on wireframe modelling, parametric representation of curves and surfaces including b-splines, NURBS, surface of revolution and curve fitting techniques; additional topic on solid representation methods including CSG and b-rep

Chapter 8 Completely revised with additional topics on trusses, beams and plane stress methods in FEA

Chapter 12 Introduction to adaptive control added

Chapter 13 More examples on part programming including simulations were added to improve the understanding of part programming

Chapter 16 More examples of APT programs are added and CAM programming is updated with Mastercam X3

Chapter 18 Enhanced classification and coding, coding systems. Added MICLASS, DCLASS, CODE and KK-3, Enhanced PFA, rank order clustering method, cellular manufacturing, and cell formation methods

Chapter 19 Added details on production planning, capacity planning and shop floor data collection

In addition to these major additions, the book has been brought up-to-date making the necessary changes throughout the book. With these major modifications, I hope the book serves a much wider spectrum of people.

Salient Features

The topics are well structured and bifurcated into sub-topics to increase the understanding. Technical terms have been used without conciliating on the reader-friendly attribute of the text. A methodical approach has been followed by first outlining the objective in the beginning of each chapter. The concepts in each chapter are explained in a very comprehensive and coherent manner substantiated effectively with the help of solved examples, figures and photographs; and exercise problems. The contents of the chapter are summarised at the end which enables quick and handy revision. Thus, this edition has been thoroughly revised and updated in order to remain in conformity with the course requirements and provide the recent and contemporary technological progress in the respective areas.

Organisation of the Book

The book is divided into five parts containing 24 chapters in all. **Chapter 1** is an introductory chapter which discusses the basics of CAD and CAM.

This is followed by **Part I** which is on hardware and software components and contains **Chapters 2 and 3**. **Chapter 2** is on CAD/CAM hardware, and **Chapter 3** is about computer graphics.

Part II which is on design of industrial products has **Chapters 3 to 8** which discuss geometric modelling, CAD standards, drafting system, modelling systems, and finite element analysis.

Part III discusses manufacturing aspects of industrial products, and contains **Chapters 9 to 16**. Computer Numerical Control (CNC) is introduced in **Chapter 9**, followed by CNC hardware basics, CNC tooling, CNC machine tools and control systems, and CNC programming in **Chapters 10, 11, 12 and 13** respectively. Turning-centre programming is explained in **Chapter 14**. **Chapters 15 and 16** thereafter deal with advanced part-programming methods and computer-aided part programming in that order.

Part IV describes the role of information systems and has **Chapters 17 to 19**. Information requirements of manufacturing are dealt with in **Chapter 17**. **Chapter 18** discusses group technology and computer aided process control. Production planning and control are explained in **Chapter 19**.

Finally, **Part V** is on integration of manufacturing systems and contains **Chapters 20 to 24**. Communications, including communication methods, direct numerical control and communication standards are examined thoroughly in **Chapter 20**. Material-handling systems and flexible manufacturing systems are explained in **Chapters 21 and 22** respectively. Computer aided quality control is discussed in **Chapter 23**. Lastly, Computer Integrated Manufacturing (CIM) is taken up in **Chapter 24**.

Web Supplements

The web supplements can be accessed at <http://www.mhhe.com/rao/cadcam/3e> and contain the following material:

For Instructors

- Solution Manual
- Chapter wise PPT's

For Students

- Interactive Objective Type Questions
- Links to Reference Material
- Sample Chapter

Feedback


Readers are once again requested to send comments and suggestions, which will be taken care of in future editions.

P N Rao

Publisher's Note

Do you have a feature request? A suggestion? We are always open to new ideas (the best ideas come from you!). You may send your comments to tmh.mefeedback@gmail.com (kindly mention the title and author name in the subject line). Piracy-related issues may also be reported.

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A book of this magnitude requires a large effort, which in many parts has been contributed by my many colleagues in various forms. It is my earnest duty, therefore, to acknowledge such contributions.

Many of my colleagues have significantly contributed in developing my ideas in CAD/CAM during their long association at the Indian Institute of Technology, New Delhi; Universiti Technology Mara, Malaysia; and University of Northern Iowa, USA. In particular, P S Nageswara Rao, A Subash Babu, N K Tewari, T K Kundra, Robert Bell, S Hinduja, U R K Rao, S R Deb, S Darius Gnanaraj, Salim, Julie Zhang, Ali Kashef and Nilmani Pramanik deserve a special mention in this regard.

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A large number of companies have liberally provided information and illustrations for use in the book. I have made an effort to provide those references along with the relevant individual illustrations. However, a mention may be made about them here:

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P Nageswara Rao

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