

# CAD/CAM/CIM



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*By*

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## **KHANNA PUBLISHERS**

4575/15, ONKAR HOUSE, GROUND FLOOR

DARYAGANJ, NEW DELHI-110002

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*Website : [www.khannapublishers.in](http://www.khannapublishers.in)*

*Published by :*

Romesh Chander Khanna & Vineet Khanna  
*for KHANNA PUBLISHERS*  
Nai Sarak, Delhi-110006.

**ISBN No. : 978-81-7409-261-8**

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***First Edition : 2014***

***Price : ₹ 200.00***

*Typesetted at : Goswami Printers, Delhi-110053.*

*Printed at : Bright Printers, Turkman Gate, Delhi-110006.*

## **Preface**

Computers today, are very versatile and powerful tool in the hands of design engineer – A tool to design, draft, model, analyze, simulate, and manufacture. The use of computer is not only helpful to design but also in the manufacture of good quality products development in the field of CAD/CAM/CIM are taking place continuously.

I am glad to present the book entitled, CAD/CAM/CIM to the engineering students of RGPV University, Bhopal. In this book we have attempted to present a balance mix of theory and practice. The aim of this book is to introduce the subject computing as an aid to design and manufacture and to take the readers from the basics of CAD/CAM/CIM application in real engineering design and manufacturing.

During long experience of teaching, the authors have observed that the students face difficulty in understanding clearly the basic principle, fundamental concept, and theory without adequate examples along with text.

The book is written in a simple and easy to follow language, So that even an average student can grasp the subject by self study. At the end of each chapter theoretical questions and unsolved numerical problems are given for students to solve them.

The book is intended for the undergraduate students of engineering and professionals, who are interested in the subject and its application to design and manufacturing.

The book is divided in six parts containing 44 chapters. All the topics contained in the chapters are explained with illustrative examples. Chapter 1 introduces the information required for manufacturing organizations, production planning systems, business forecasting, material requirement planning, aggregate production planning and concurrent engineering. These texts are well covered in the chapters 2-9.

Part 2 and 3 covers the CAD/CAM computer graphics, standards, and geometric modeling. Coordinate system, computer data management, CAD data standardization, and drawing data exchange formats are explained in detail in the chapters 10-17. Geometric modeling, constructive solid geometry, surface representation, polynomial curve fitting and rapid prototyping are demonstrated and discussed in the chapters 18-26.

Part 4 Introduces NC, CNC and DNC systems, part programming methods, G-codes, M-codes, ATC pallets, and machining time estimation are discussed very well in the chapters 27-32 while adaptive, sequence control and PLC explained in the chapters 33-35.

Part 5 Deals with Group technology, concept of part family and coding systems in the chapters 36-37. Flexible manufacturing covers material handling, AGV, robots, and computer aided process planning in the chapters 38-41

Part 6 Briefly discusses computer integrated manufacturing, product design and product life cycle management in chapters 42-44.

We have tried to make the book as student friendly as possible. Readers are requested to send comments and suggestions, which will be taken care of the future editions.

**K.C. Jain  
Vikas Gohil**



## ***Acknowledgement***

This book could not be written to its fullest without Prof. K.C. Jain, who served as my supervisor, as well as one who challenged and encouraged me throughout my time spent writing under him. He would have never accepted anything less than my best efforts, and for that. I thank him.

The book is dedicated to my parents and family members for believing in me and for always being there. My father is my cheerleader.

Finally I thank to !! LORD VENKATESWARA !!

**Vikas Gohil**



# **Contents**

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1. Historical Background and Development in Manufacturing	...	1–16
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## **PART I: BUSINESS INFORMATION AND MANUFACTURING PLANNING**

2. Productivity and Creation of Wealth	...	19–26
3. Manufacturing as a System	...	27–32
4. Information Integration for Manufacturing Planning	...	33–46
5. Business Forecasting	...	47–83
6. Production Systems and High Volume Production	...	84–100
7. Aggregate Production Planning	...	101–113
8. Material Requirement Planning	...	114–126
9. Design for Manufacturing and Concurrent Engineering	...	127–140

## **PART II: COMPUTER GRAPHICS AND STANDARDS**

10. Introduction	...	143–144
11. Coordinate System and Raster Scan	...	145–158
12. Database for Graphic Modelling	...	159–161
13. Computer Data Management	...	162–168
14. Transformation of Geometry	...	169–178
15. Introduction to Modelling Software's	...	179–180
16. CAD Standardization	...	181
17. Drawing Data Exchange Formats	...	182–186

## **PART III: GEOMETRIC MODELING**

18. Introduction	...	188–192
19. Geometric Model Representation	...	193–201
20. Constructive Solid Geometry (CSG)/ Primitive Modeling	...	202–203
21. Basic of Boundary Representation	...	204–210

22. Classification of Surfaces	...	211–213
23. Constraints Based Modeling (Parametric Modeling)	...	214–215
24. Wireframe Modeling	...	216–219
25. Polynomial Curve Fitting	...	220–221
26. Rapid Prototyping	...	222–233

#### **PART IV: CAM-I**

27. Fundamentals of Numeric Control and Part Programming	...	237–238
28. Numerical Control Concept and Definition	...	239–274
29. NC, CNC Part Programming	...	275–290
30. ISO Standards for Coding	...	291–302
31. Tool Path Simulation	...	303–304
32. ISO Codes for Turning Tools and Holders	...	305–308
33. Automatic Tool Changer (ATC)	...	309–318
34. Time and Power Estimation in CNC Machining	...	319–321
35. Adaptive Control, Sequence Control and PLC	...	322–347

#### **PART V: (CAM - II) GROUP TECHNOLOGY AND ELEMENTS OF FMS**

36. Group Technology	...	351–366
37. Concept of Part Families and Coding	...	367–376
38. Flexible Manufacturing System	...	377–403
39. Automated Material Handling	...	404–433
40. Automated Guided Vehicle (AGV) Systems	...	434–447
41. Computer Aided Process Planning	...	448–454

#### **PART VI: CAM - 6 (CIM) COMPUTER INTEGRATED MANUFACTURING (CIM)**

42. CIM Concept, Definition and Implementation	...	457–486
43. Product Design in CIM Environment	...	487–498
44. Product Life Cycle Management and CIM	...	499–508

# 1

## Historical Background and Development in Manufacturing

### 1.1 HISTORICAL BACKGROUND

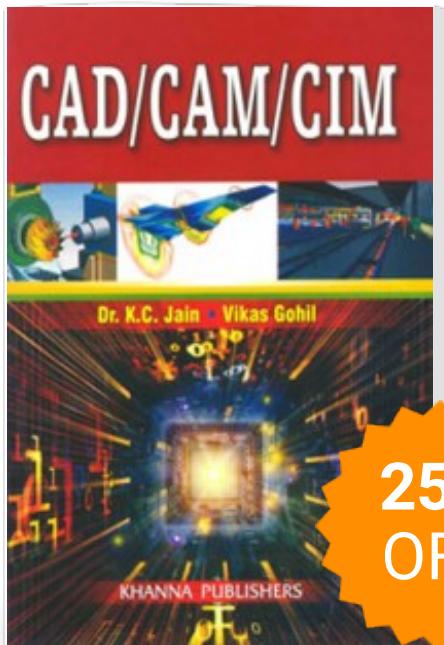
The word manufacture is derived from two Latin words manus (hand) and factus (make); the combination means made by hand. Manufacturing is the process of converting raw materials into finished goods using labour and machines that meet a customer's expectations or specifications.

History of civilization/manufacturing is as old as the civilization itself. Phase I is of creativity i.e. man's discovery and invention for materials, processes and products is known as 'Development of Process'. Phase II: Organizing for mass manufacturing or a production system so as to organize man, material and equipment for efficient production.

**Table 1.1 History of Manufacturing**

S. No.	<i>Period and its Historical Name</i>	<i>Development of different processes and machines</i>
1.	8000-3000 BC (Neolithic Period)	<ul style="list-style-type: none"><li>(i) Wood-working, forming, Firing of clay Pottery, Grinding and Polishing of stone, Spinning and Weaving of textiles, Dyeing of clothes, etc.</li><li>(ii) Metallurgy and Metal-working also began during this period, in Mesopotamia.</li><li>(iii) Copper was probably the first metal to be extracted from ores, thus smelting was developed as a processing technique.</li><li>(iv) Casting technique was developed for copper, as copper can not be easily hammered.</li></ul>
2.	3500-1500 BC (Bronze Age)	<ul style="list-style-type: none"><li>(i) Silver and Tin were discovered. It was also found that copper alloyed with tin and silver produced a more workable metal than copper alone, known as Bronze. Casting and hammering could both be used for bronze.</li><li>(ii) Iron was also first smelted during this period.</li><li>(iii) The temperatures required to reduce iron ore to metal are significantly higher than for copper, which made furnace operations more difficult.</li></ul>
3.	1000 BC (Iron Age)	<ul style="list-style-type: none"><li>(i) Different types of Irons that contains variable percentage of carbon.</li><li>(ii) Heating and Quenching techniques.</li><li>(iii) Heat treatment of steel.</li><li>(iv) The superior properties of steel caused it to succeed in many applications like, weaponry, agriculture and mechanical devices etc.</li></ul>

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Publisher : KHANNA  
PUBLISHERS

ISBN : 9788174092618

Author : K.C. Jain and  
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Type the URL : <http://www.kopykitab.com/product/4319>



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