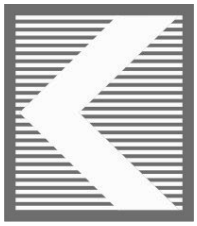
ENGINEERING GRAPHICS & DESIGN

PRADEEP JAIN



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ISBN: 978-93-91505-06-6
Book Code: UG004EN

Engineering Graphics & Design

by Pradeep Jain
[English Edition]

First Edition: 2021

Published by:

Khanna Book Publishing Co. (P) Ltd.
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CIN: U22110DL1998PTC095547

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FOREWORD

Engineering has played a very significant role in the progress and expansion of mankind and society for centuries. Engineering ideas that originated in the Indian subcontinent have had a thoughtful impact on the world.

All India Council for Technical Education (AICTE) had always been at the forefront of assisting Technical students in every possible manner since its inception in 1987. The goal of AICTE has been to promote quality Technical Education and thereby take the industry to a greater heights and ultimately turn our dear motherland India into a Modern Developed Nation. It will not be inept to mention here that Engineers are the backbone of the modern society - better the engineers, better the industry, and better the industry, better the country.

NEP 2020 envisages education in regional languages to all, thereby ensuring that each and every student becomes capable and competent enough and is in a position to contribute towards the national growth and development.

One of the spheres where AICTE had been relentlessly working from last few years was to provide high-quality moderately priced books of International standard prepared in various regional languages to all it's Engineering students. These books are not only prepared keeping in mind it's easy language, real life examples, rich contents and but also the industry needs in this everyday changing world. These books are as per AICTE Model Curriculum of Engineering & Technology – 2018.

Eminent Professors from all over India with great knowledge and experience have written these books for the benefit of academic fraternity. AICTE is confident that these books with their rich contents will help technical students master the subjects with greater ease and quality.

AICTE appreciates the hard work of the original authors, coordinators and the translators for their endeavour in making these Engineering subjects more lucid.

(**Anil D. Sahasrabudhe**)

Acknowledgement

The author grateful to AICTE for their meticulous planning and execution to publish the technical book for Engineering and Technology students.

I sincerely acknowledge the valuable contributions of the reviewer of the book Prof. B.S. Pabla, for making it students' friendly and giving a better shape in an artistic manner.

This book is an outcome of various suggestions of AICTE members, experts and authors who shared their opinion and thoughts to further develop the engineering education in our country.

It is also with great honour that I state that this book is aligned to the AICTE Model Curriculum and in line with the guidelines of National Education Policy (NEP) -2020. Towards promoting education in regional languages, this book is being translated in scheduled Indian regional languages.

Acknowledgements are due to the contributors and different workers in this field whose published books, review articles, papers, photographs, footnotes, references and other valuable information enriched us at the time of writing the book.

Finally, I like to express my sincere thanks to the publishing house, M/s. Khanna Book Publishing Company Private Limited, New Delhi, whose entire team was always ready to cooperate on all the aspects of publishing to make it a wonderful experience.

Pradeep Jain

Preface

The traditional engineering graphics course has undergone significant change due to emergence of computer-aided drafting and design (CAD) tools and the revision of engineering graphics curriculum to include computer based 2D and 3D modeling. The emphasis has shifted from drawing board based engineering graphics to CAD based modeling which has the advantages of speed, flexibility and convenience of drawing. In spite of these the focus on free hand sketching and development of ability to visualize the objects in 2D and 3D frame has been retained in the revised curriculum. The text book on "Engineering Graphics & Design" addresses the challenges of integrating computer aided drawing and design to develop the drafting manual skills and to integrate the computer based drafting without losing focus on the basic drawing skills. The book has been aligned to outcome based education to focus on the learning outcomes leading to attainment of program outcomes. Course outcomes and unit outcomes have been defined for each unit of the curriculum. COs have been mapped with the POs to enable the students to appreciate and work for attainment of program outcomes. The text matter has been reduced to make it easier to students. Each chapter is followed by a set of questions and the references for further reading. The first part of the book covers the conventional aspects of engineering drawing and the second part is devoted to the use of computer aided drafting.

It is sincerely hoped that the book will redefine the learning of engineering graphics and design with focus on development of visualization of engineering objects and use of computer software in developing 2D and 3D models.

Author will thankfully acknowledge the comments and suggestions for the future improvements of the book.

Pradeep Jain

Outcome Based Education

For the implementation of an outcome based education the first requirement is to develop an outcome based curriculum and incorporate an outcome based assessment in the education system. By going through outcome based assessments evaluators will be able to evaluate whether the students have achieved the outlined standard, specific and measurable outcomes. With the proper incorporation of outcome based education there will be a definite commitment to achieve a minimum standard for all learners without giving up at any level. At the end of the programme running with the aid of outcome based education, a student will be able to arrive at the following outcomes:

PO-1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes

After completion of the course the students will be able to:

CO-1: Demonstrate the visual understanding of engineering drawing.

CO-2: Create working engineering drawings.

CO-3: Apply computer aided drafting for 2 D and 3 D modeling.

CO-4: Apply the modern engineering tools necessary for engineering practice.

CO-5: Read and communicate through engineering drawings.

Mapping of Course Outcomes with Programme Outcomes

Course Outcomes	Expected Mapping with Program Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	-	-	1	-	-	-	-	-	-
CO-2	3	3	2	2	-	-	-	-	-	-	-	-
CO-3	3	2	3	1	3	2	-	-	-	-	-	-
CO-4	3	2	1	1	3	2	-	-	-	-	-	-
CO-5	3	2	2	-	-	2	-	-	-	3	-	-

Abbreviations

2D	Two Dimensional
3D	Three Dimensional
Aux	Auxiliary
BIS	Bureau of Indian Standards
CAD	Computer-aided design
CO	Course Outcome
CUI	Customize User Interface
FV	Front View
GUI	Graphical User Interface
HP	Horizontal plane
HT	Horizontal trace
IS	Indian standard
ISO	International Organization for Standardization
LOS	Line of Sight
OSNAP	Object SNAP
PO	Programme Outcomes
PP	Profile Plane
RF	Representative Fraction
THK	Thick
TL	True Length
TV	Top View
UCS	User Coordinate System
UO	Unit Outcomes
VP	Vertical Plane
VT	Vertical Trace

List of Figures

UNIT 3: PROJECTION OF SOLIDS

UNIT 4: SECTIONAL VIEWS OF SOLIDS

UNIT 5: ISOMETRIC PROJECTION

UNIT 6: OVERVIEW OF COMPUTER GRAPHICS

List of Tables

Guidelines for Teachers

To implement Outcome Based Education (OBE) knowledge level and skill set of the students should be enhanced. Teachers should take a major responsibility for the proper implementation of OBE. Some of the responsibilities (not limited to) for the teachers in OBE system may be as follows:

- Within reasonable constraint, they should manipulate time to the best advantage of all students.
- They should assess the students only upon certain defined criterion without considering any other potential ineligibility to discriminate them.
- They should try to grow the learning abilities of the students to a certain level before they leave the institute.
- They should try to ensure that all the students are equipped with the quality knowledge as well as competence after they finish their education.
- They should always encourage the students to develop their ultimate performance capabilities.
- They should facilitate and encourage group work and team work to consolidate newer approach.
- They should follow Blooms taxonomy in every part of the assessment.

Bloom's Taxonomy

Level	Teacher should Check	Student should be able to	Possible Mode of Assessment
Creating	Students ability to create	Design or Create	Mini project
Evaluating	Students ability to Justify	Argue or Defend	Assignment
Analysing	Students ability to distinguish	Differentiate or Distinguish	Project/Lab Methodology
Applying	Students ability to use information	Operate or Demonstrate	Technical Presentation/ Demonstration
Understanding	Students ability to explain the ideas	Explain or Classify	Presentation/Seminar
Remembering	Students ability to recall (or remember)	Define or Recall	Quiz

Guidelines for Students

Students should take equal responsibility for implementing the OBE. Some of the responsibilities (not limited to) for the students in OBE system are as follows:

- Students should be well aware of each UO before the start of a unit in each and every course.
- Students should be well aware of each CO before the start of the course.
- Students should be well aware of each PO before the start of the programme.
- Students should think critically and reasonably with proper reflection and action.
- Learning of the students should be connected and integrated with practical and real life consequences.
- Students should be well aware of their competency at every level of OBE.

Contents