



# ENGINEERING GRAPHICS



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*by* Sharad K. Pradhan, K.K. Jain

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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

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The author(s) are grateful to AICTE for their meticulous planning and execution to publish the technical book for Diploma students.

We sincerely acknowledge the valuable contributions of the reviewer of the book Prof. T K Shrivastava, 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 we 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, we like to express our 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.

**Sharad K. Pradhan**  
**K.K. Jain**



# Preface

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The book Engineering Graphics is intended to provide comprehensive and schematic knowledge to the students of diploma of engineering and technology courses related to conventional and digital engineering drawing practices. The book covers all the topics mentioned in the AICTE Model curriculum for Diploma in Engineering and Technology 2019 related to 'Engineering Graphics' course in a very systematic and orderly manner. All the topics are explained in a conceptual and step by step manner with proper illustrations.

The chapters matter is written in accordance with 'Engineering Drawing Practices for School and Colleges SP 46:2003', published by Bureau of Indian Standards, Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2, Manak Bhavan. Different standard books and available literature on the topic are also referred to make the book complete in all aspects. Care has been taken to include illustrations and figures to make each topic easy to understand. Solved examples and videos are included to support the learning of the students related to difficult to understand topics.

The book comprises of six units. First four units are on conventional engineering drawing practices using manual drawing instruments while the last two chapters are on digital engineering drawing using computer hardware and drafting software (AutoCAD). Apart from essential information a 'Know More' section is also provided in each unit to extend the learning beyond syllabus.

In start of each unit learning outcomes are listed to make the student understand what is expected out of him/her after completing that unit. Further, the unit outcome are mapped with the course outcomes mention in the initial pages of the book so that the student will always in a position to correlate outcomes achieved in each unit with the overall targeted course outcomes.

We are hopeful that the book will motivate the students to learn this difficult and skill based course 'Engineering Graphics' and make them able to draw the entities using both manual drawing instruments and computer aided drafting software. Authors are thankful to all suggestions made by reviewers, translators and stakeholders to make this book effective and beneficial to all concerned. It was a great learning experience for us and still the comments and suggestions are most welcome so that the coming version of the book can be improved for better learning of the course.

**Sharad K. Pradhan**  
**K.K. Jain**



# Outcome Based Education

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Outcome based education is based on Outcome based curriculum, Outcome based Teaching-Learning Process and Outcome based Assessment to achieve targeted learning outcomes at each level. As per National Board of Accreditation, after completion of diploma program in engineering and technology the graduate will be able to:

- PO1. Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
- PO2. Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
- PO3. Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
- PO4. Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- PO5. Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- PO6. Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- PO7. Life-long learning:** Ability to analyse individual needs and engage in updating in the context of Technological changes.

# Course Outcomes

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

- CO-1. Draw geometrical figures and engineering scales.
- CO-2. Use drawing codes, dimensioning, conventions and symbols as per IS SP-46(2003) in engineering drawing.
- CO-3. Draw the views of given object using principles of orthographic projection.
- CO-4. Draw isometric views of given component directly or from orthographic projections.
- CO-5. Draw free hand sketches of given engineering elements, their orthographic view and isometric view.
- CO-6. Use computer aided drafting software to draw 2D geometric entities.

Course Outcomes	EXPECTED MAPPING WITH COURSE OUTCOMES (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
CO-1	3	-	-	3	-	1	-
CO-2	3	-	-	3	2	1	-
CO-3	3	1	1	3	-	1	2
CO-4	3	1	1	3	-	1	2
CO-5	3	-	1	3	-	-	2
CO-6	3	-	1	3	-	-	2

# Abbreviations and Symbols

## List of Abbreviations

General terms			
Abbreviations	Full form	Abbreviations	Full form
CO	Course Outcome	TV	Top View
PO	Program Outcome	FV	Front View
UO	Unit Outcome	SV	Side View
LO	Learning Outcome	LSV	Left Side View
BIS	Bureau of Indian Standards	RSV	Right Side View
ISI	Indian Standards Institutions	MS	Microsoft
CAD	Computer Aided Design	CD	Compact Disc
CADr	Computer Aided Drafting	HD	Hard Disk/Drive
V.P.	Vertical reference Plane	PC	Personal Computer
H.P.	Horizontal reference Plane	I/O	Input/Output
RF	Representative fraction	CPU	Central Processing Unit
UCS	User Coordinate System	2D	Two Dimensional
WCS	World Coordinate System	3D	Three Dimensional
QR Code	Quick Response Code		
Unit used			
mm	millimeter	km	kilometers
cm	centimeter	GH	Gega Hertz
m	meters	GB	Gega Bite

## List of Symbols

Abbreviations	Full form	Abbreviations	Full form
D, $\emptyset$	Diameter	M	Metric
R	Radius	L	Lenght
o	Degree	B, W	Width
$\frown$	Arc	H, h	Height
$\theta$	Theta, Angle	t	Thickness
P	Pitch		

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# Guidelines for Teachers

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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 manoeuvre 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. For assessment of practical work suggestive performance indicators are mentioned at the end of practical in each unit.

## 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.



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