[ PLANE AND SOLID GEOMETRY ]
By
N. Dhatt

| Edition | $: 5^{\text {nd }}$ Edition $: 2013$ |
| :--- | :--- |
| ISBN | $: 978-93-80358-83-3$ |
| Size | $: 170 \mathrm{~mm} \times 235 \mathrm{~mm}$ |
| Binding | $:$ Paperback with Four color Jacket Cover |
| Pages | $: 728+16$ |

The book covers the syllabi in Engineering Drawing as a core subject for Degree Examinations of all the Indian Universities, Diploma Examinations conducted by various Boards of Technical Education, Certificate Courses, I.T.I. as well as for the A.M.I.E., U.P.S.C., G.A.T.E., I.E.S. and other similar competitive and professional examinations. It should also prove of interest to the practising professionals.

* 1617 Self-explanatory and neatly drawn diagrams
* 523 Worked examples (Problems)
* 900 Exercises at the end of chapters
* 34 Useful tables


#### Abstract

\section*{ABOUT THE BOOK}

The book provides all aspects and detailed study of Engineering Drawing- Plane and Solid Geometry, a core subject for all branches of Engineering study, presented in a lucid manner and easy-to-follow style. The text book follows the first-angle method of orthographic projection, however, the third-angle projection method has not been completely ignored. The entire book is printed in two colour which enhance the utility of the book.

In this Fifty-first Edition some errors are rectified. The earlier Fiftieth Edition of this text-book is thoroughly revised, extensively enlarged, completely updated. It has been one of the most comprehensive revisions since the book was first published. As a result, all the drawings have been redrawn with utmost intelligibility. Many new examples, drawings are incorporated along with some new text matter. Chapter on Computer Aided Drafting (CADr) is entirely rewritten with inclusion of 50 self-interactive and self-learning practice modules.

This book accompanied by a computer CD as a novel pedagogical concept, containing 51 selected audiovisual animation modules presented for better visualization and understanding of the subject.

The solutions to exercises of Chapter 17, Isometric Projection and Chapter 20 Conversion of Views are given in this edition.

The topics of the subject are covered in 26 well-arranged chapters - therein it now contains:



₹ 250.00

# ENGINEERING DRAWING <br> DETAILED CONTENTS 

## Chapter 1 DRAWING INSTRUMENTS AND THEIR USES

1-1. Introduction
1-2. Drawing board
1-3. T-square
1-4. Set-squares
1-5. Drawing instrument box
(1) Large-size compass with inter chang eable pencil and pen legs
(2) Lengthening bar
(3) Small bow compass
(4) Large-size divider
(5) Small bow divider
(6) Small bow ink-pen
(7) Inking pen

1-6. Scales
1-7. Protractor
1-8. French curves
1-9. Drawing papers
1-10. Drawing pencils
1-11. Eraser (Rubber)
1-12. Drawing pins, Clips or adhesive tapes
1-13. Sand-paper block
1-14. Duster
1-15. Drafting machine
1-16. Roll-N-Draw
1-17. General suggestions for drawing a sheet
(1) Cleaning the instruments
(2) Pinning the paper to the drawing board
(3) Border lines
(4) Spacing of drawings

Exercises I

## Chapter 2 SHEET LAYOUT AND FREE-HAND SKETCHING

2-1. Sheet layout
(1) Sheet sizes
(2) Margin
(3) Border lines
(4) Borders \& frames
(5) Orientation mark
(6) Grid reference system
(7) Title block
(8) List of parts or the bill of materials
(9) Revisions of drawing
(10) Folding marks
(11) Scales and scale drawing

2-2. Types of machine drawings
(1) Production drawing
(2) Exploded assembly drawing
(3) Schematic assembly drawing
(4) Drawing for instruction manual
(5) Drawing for installation
(6) Drawing for catalogue
(7) Tabular drawing
(8) Patent drawing

2-3. Free-hand Sketching
(1) Sketching or freehand
(2) Sketching materials
(3) To sketch straight lines
(4) To sketch circles and arcs
(5) Sketching procedure
(6) Steps in sketching

Exercises II

Chapter 3 LINES, LETTERING AND DIMENSIONING
3-0. Introduction
3-1. Lines
(1) Line thickness
(2) Inked drawings
(3) Pencil drawings

3-1-1. Types of Lines
(1) Outlines
(2) Margin lines
(3) Dimension lines
(4) Extension or projection lines
(5) Construction lines
(6) Hatching or section lines
(7) Leader or pointer lines
(8) Border lines
(9) Short-break lines
(10) Long-break lines
(11) Hidden or dotted lines
(12) Centre lines
(13) Cutting-plane lines
(14) Chain thick
(15) Chain thick double-dots

3-2. Lettering
(1) Single-stroke letters
(2) Gothic letters

3-3. Dimensioning
3-4. Dimensioning terms and notations
(1) Dimension line
(2) Extension line
(3) Arrowhead
(4) Leader

3-5. Placing of dimensions
(1) Aligned system
(2) Unidirectional system

3-6. Unit of dimensioning
3-7. General rules for dimensioning
3-8. Practical hints on dimensioning Exercises III

## Chapter 4 SCALES

4-1. Introduction
4-2. Scales
(1) Engineer's
(2) Graphical scale
(3) Representative fraction

4-3. Scales on drawings
$4-4$. Types of scales
(1) Plain scales
(2) Diagonal scales
(3) Comparative scales
(4) Vernier scales
(5) Scale of chords

Exercises IV

## Chapter 5 GEOMETRICAL CONSTRUCTION

5-0. Introduction
5-1. Bisecting a line
5-2. To draw perpendiculars
5-3. To draw parallel lines
5-4. To divide a line
5-5. To divide a circle
5-6. To bisect an angle

# ENGINEERING DRAWING <br> DETAILED CONTENTS 

5-7. To trisect an angle
$5-8$. To find the centre of an arc
5-9. To construct an ogee or reverse curve
5-10. To construct equilateral triangles
5-11. To construct squares
5-12. To construct regular polygons
5-13. Special methods of drawing regular polygons
5-14. Regular polygons inscribed in circles
$5-15$. To draw regular figures using T -square and set-squares
5-16. To draw tangents
5-17. Lengths of arcs
$5-18$. Circles and lines in contact
5-19. Inscribed circles
Exercises V
Chapter 6 CURVES USED IN ENGINEERING PRACTICE
6-0. Introduction
6-1. Conic sections
6-1-1. Ellipse
6-1-2. Parabola
6-1-3. Hyperbola
6-1-4. Tangents and normals to conics
6-2. Cycloidal curves
6-2-1. Cycloid
6-2-2. Trochoid
6-2-3. Epicycloid and hypocycloid
6-2-4. Epitrochoid
6-2-5. Hypotrochoid
6-3. Involute
6-4. Evolutes
6-5. Spirals
6-5-1. Archemedian spiral
6-5-2. Logarithmic or equiangular spiral
6-6. Helix
6-6-1. A method of drawing a helical curve
6-6-2. Helical springs
6-6-3. Screw threads
6-6-4. Helix upon a cone
6-7. Cam Exercises VI

## Chapter 7 LOCI OF POINTS

7-0. Introduction
$7-1$. Loci of points
7-2. Simple mechanisms
7-2-1. The slider crank mechanism
(1) Simple slider crank mechanism
(2) Offset slider crank mechanism

7-2-2. A four-bar mechanism
Exercises VII
Chapter 8 ORTHOGRAPHIC PROJECTION
8-0. Introduction
8-1. Principle of projection
8-2. Methods of projection
8-3. Orthographic projection
8-4. Planes of projection
$8-5$. Four quadrants
8-6. First-angle projection
8-7. Third-angle projection
8-8. Reference line
8-9. B.I.S. code of practice
8-10. Typical Problems
Exercises VIII

## Chapter 9 PROJECTIONS OF POINTS

9-0. Introduction
$9-1$. A point is situated in the first quadrant
$9-2$. A point is situated in the second quadrant
9-3. A point is situated in the third quadrant
9-4. A point is situated in the fourth quadrant
9-5. General conclusions
Exercises IX

## Chapter 10 PROJECTIONS OF STRAIGHT LINES

10-0. Introduction
10-1. Line parallel to one or both the planes
$10-2$. Line contained by one or both the planes
$10-3$. Line perpendicular to one of the planes
10-4. Line inclined to one plane and parallel to the other Exercises X(a)
10-5. Line inclined to both the planes
$10-6$. Projections of lines inclined to both the planes
10-7. Line contained by a plane perpendicular to both the reference planes
$10-8$. True length of a straight line and its inclinations with the reference planes
10-9. Traces of a line
10-10. Methods of determining traces of a line
10-11. Traces of a line, the projections of which are perpendicular to xy
10-12. Positions of traces of a line
10-13. Additional illustrative problems Exercises X(b)

## Chapter 11 PROJECTIONS ON AUXILIARY PLANES

11-0. Introduction
11-1. Types of auxiliary planes and views
11-2. Projection of a point on an auxiliary plane
11-3. Projections of lines and planes by the use of auxiliary planes
11-4. To determine true length of a line
11-5. To obtain point-view of a line and edge-view of a plane
11-6. To determine true shape of a plane figure Exercises XI

## Chapter 12 PROJECTIONS OF PLANES

12-0. Introduction
12-1. Types of planes
(1) Perpendicular planes
(2) Oblique planes

12-2. Traces of planes
12-3. General conclusions
(1) Traces
(2) Projections

12-4. Projections of planes parallel to one of the reference planes
(1) When the plane is parallel to the H.P.
(2) When the plane is parallel to the V.P.

12-5. Projections of planes inclined to one reference plane and perpendicular to the other
(1) Plane, inclined to the H.P. and perpendicular to the V.P.
(2) Plane, inclined to the V.P. \& perpendicular to the H.P.

12-6. Projections of oblique planes
Exercises XII

## Chapter 13 PROJECTIONS OF SOLIDS

13-0. Introduction
13-1. Types of solids
(1) Polyhedra
(2) Solids of revolution

13-2. Projections of solids in simple positions Exercises XIII(i)
13-3. Projections of solids with axes inclined to one of the reference planes and parallel to the other

## ENGINEERING DRAWING <br> DETAILED CONTENTS

13-3-1. Axis inclined to the V.P. and parallel to the H.P.
13-3-2. Axis inclined to the H.P. and parallel to the V.P.
13-4. Projections of solids with axes inclined to both the H.P. and the V.P.
13-5. Projections of spheres
(1) Spheres in contact with each other
(2) Unequal spheres

Exercises XIII(ii)

## Chapter 14 SECTIONS OF SOLIDS

14-0. Introduction
(1) Section planes
(2) Sections
(3) True shape of a section

14-1. Sections of prisms
(1) Section plane parallel to the V.P.
(2) Section plane parallel to the H.P.
(3) Section plane perpendicular to the H.P. and inclined to the V.P.
(4) Section plane perpendicular to the V.P. and inclined to the H.P.
14-2. Sections of pyramids
(1) Section plane parallel to the base of the pyramid
(2) Section plane parallel to the V.P.
(3) Section plane perpendicular to the V.P. and inclined to the H.P.
(4) Section plane perpendicular to the H.P. and inclined to the V.P
14-3. Sections of cylinders
(1) Section plane parallel to the base
(2) Section plane parallel to the axis
(3) Section plane inclined to the base

14-4. Sections of cones
(1) Section plane parallel to the base of the cone
(2) Section plane passing through the apex of the cone
(3) Section plane inclined to the base of the cone at an angle smaller than the angle of inclination of the generators with the base
(4) Section plane parallel to a generator of the cone
(5) Section plane inclined to the base of the cone at an angle greater than the angle of inclination of the generators with the base
14-5. Sections of spheres
(1) Section plane parallel to the H.P.
(2) Section plane parallel to the V.P.
(3) Section plane perpendicular to the V.P. and inclined to the H.P.
(4) Section plane perpendicular to the H.P. and inclined to the V.P.
14-6. Typical Problems of Sections of Solids
Exercises XIV

## Chapter 15 DEVELOPMENT OF SURFACES

15-0. Introduction
15-1. Methods of development
(1) Parallel-line development
(2) Radial-line development
(3) Triangulation development
(4) Approximate method

15-2. Developments of lateral surfaces of right solids
15-2-1. Cube
15-2-2. Prisms
15-2-3. Cylinders
15-2-4. Pyramids
15-2-5. Cone
15-3. Development of transition pieces
15-4. Spheres
Exercises XV

## Chapter 16 INTERSECTION OF SURFACES

## 16-0. Introduction

16-1. Line of intersection
16-2. Methods of determining the line of intersection between surfaces of two interpenetrating solids
(1) Line method
(2) Cutting-plane method

16-3. Intersection of two prisms
16-4. Intersection of cylinder and cylinder
16-5. Intersection of cylinder \& prism
16-6. Intersection of cone \& cylinder
16-7. Intersection of cone \& prism
16-8. Intersection of cone and cone
16-9. Intersection of sphere and cylinder or prism Exercises XVI

## Chapter 17 ISOMETRIC PROJECTION

## 17-1. Introduction

17-2. Isometric axes, lines \& planes
17-3. Isometric scale
17-4. Isometric drawing or isometric view
17-5. Isometric graph
17-6. Illustrative problems
17-6-1. Isometric drawing of planes or plane figures
17-6-2. Isometric drawing of prisms and pyramids
17-6-3. Isometric drawing of cylinders
17-6-4. Isometric drawing of cones
17-6-5. Isometric drawing of sphere
17-7. Typical problems of isometric drawing Exercises XVII
Solutions to Exercises XVII

## Chapter 18 OBLIQUE PROJECTION

18-1. Introduction
18-2. Principle of the oblique projection
18-3. The oblique projection and the isometric projection
18-4. Receding lines \& receding angles
18-5. Types of the oblique projection
18-6. Rules for the choice of position of an object
18-7. Steps for drawing the oblique projection
18-8. Oblique drawing of pyramid
18-9. Oblique drawing of circle
(1) Offset method
(2) Four centre approximate method

18-10. Oblique drawing of cylinder
18-11. Oblique drawing of prism
18-12. Typical problems of oblique projection Exercises XVIII

## Chapter 19 PERSPECTIVE PROJECTION

19-1. Introduction
19-2. Principle of perspective projection
19-3. Definitions of perspective elements
(1) Ground plane
(2) Station point
(3) Picture plane
(4) Horizontal plane
(5) Auxiliiary ground plane
(6) Ground line
(7) Horizon line
(8) Perpendicular axis
(9) Centre of vision
(10) Central plane

# ENGINEERING DRAWING <br> DETAILED CONTENTS 

19-4. Station point
19-5. Angle of vision
19-6. Picture plane
19-7. Methods of drawing perspective view
19-7-1. Visual-ray method
19-7-2. Vanishing-point method
19-8. Types of perspective
(1) Parallel perspective or one point perspective
(2) Angular perspective or two point perpective
(3) Oblique perspective or three point perspective

19-9. Distance points
19-10. Measuring line or line of heights
19-11. Perspectives of circles \& solids
19-12. Typical problems of perspective projection
(1) Visual-ray method - by means of the top view and the front view
(2) Visual-ray method - by means of the top view and the side view
(3) Vanishing-point method

Exercises XIX

## Chapter 20 ORTHOGRAPHIC READING AND CONVERSION OF VIEWS

20-1. Introduction
20-2. Reading of orthographic views (Blue-print reading)
20-3. Missing lines and missing views
20-4. Identification of planes
20-5. Conversion of pictorial views into orthographic views
20-6. Orthographic projection
20-7. Procedure for preparing a scale-drawing
20-8. Illustrative problems
Exercises XX

## Chapter 21 CENTRES OF GRAVITY AND MOMENTS OF INERTIA OF AREAS

21-0. Introduction
21-1. Centre of gravity
21-1-1. Centres of gravity of symmetrical areas
21-1-2. Centres of gravity of unsymmetrical areas
21-1-3. Illustrative problems on centre of gravity
21-2. Moments of inertia of areas
(1) Definition, (2) Unit
(3) Graphical method

21-3. Illustrative problems on moments of inertia
Exercises XXI

## Chapter 22 NOMOGRAPHY

22-0. Introduction
22-1. Types of nomographs
22-2. Definitions of various terms
22-3. Principle of construction of nomographs of three variables
22-4. Method of constructing parallel scale nomographs
22-5. Layout of nomographs
22-6. Z-type nomographs
Exercises XXII

## Chapter 23 SCREW THREADS

23-0. Introduction
23-1. Definitions
(1) Crest,
(2) Root, (3) Flank, (4) Angle
(5) Depth, (6) Nominal diameter
(7) Outside or major diameter
(8) Core or minor diameter
(9) Effective diameter
(10) Pitch, (11) Lead, (12) Slope

23-2. Forms of screw threads
23-2-1. Triangular or V threads
(1) Unified thread
(2) Metric thread
(3) Whitworth thread
(4) British Standard Fine and British Standard Pipe threads
(5) Sellers thread
(6) British Association thread

23-2-2. Square thread
(1) Acme thread
(2) Knuckle thread
(3) Buttress thread

23-3. Conventional representation of threads SP: 46-2003
23-4. Multiple-start threads
23-5. Right-hand \& left-hand threads Exercises XXIII

## Chapter 24 SCREWED FASTENINGS

24-0. Introduction
24-1. Types of nuts
24-1-1. Hexagonal nut
24-1-2. Square nut
24-2. Types of nuts for special purpose
(1) Flanged nut
(2) Cap nut
(3) Dome nut
(4) Cylindrical or capstan nut
(5) Ring nut
(6) Wing nut

24-3. Washers
24-4. Bolts
24-5. Forms of bolts
(1) Hexagonal-headed bolt
(2) Square-headed bolt
(3) Cylindrical or cheese-headed bolt
(4) Cup-headed or round-headed bolt
(5) T-headed bolt
(6) Countersunk-headed bolt
(7) Hook bolt
(8) Headless tapered bolt
(9) Eye-bolt
(10) Lifting eye-bolt
(11) Tap-bolt or cap-screw
(12) Stud-bolt or stud

24-6. Set-screws
24-7. Locking arrangements for nuts
(1) Lock-nut or check-nut
(2) Split-pin
(3) Slotted nut
(4) Castle nut
(5) Sawn nut or Wiles nut
(6) Simmond's lock-nut
(7) Penn, ring or grooved nut
(8) Stop-plate or locking-plate
(9) Spring-washer

24-8. Foundation bolts
(1) Eye or Hoop bolt
(2) Rag bolt
(3) Lewis bolt
(4) Cotter bolt
(5) Curved or bent bolt
(6) Squar-headed bolt

24-9. Spanner
24-10. Longitudinal or bar stay
24-11. Conventional symbols for nuts and bolts Exercises XXIV

## ENGINEERING DRAWING <br> DETAILED CONTENTS

| Chapter 25 RIVETED JOINTS AND WELDED JOINTS | 26-3-1. Processor (CPU) |
| :---: | :---: |
| 25-1. Introduction | 26-3-2. Display |
| 25-2. Riveting | 26-3-3. INPUT Devices |
| 25-2-1. Caulking and fullering | 26-3-4. Graphic Output Devices |
| 25-3. Forms and proportions of rivet-heads | 26-4. CAD Software |
| 25-4. Failure of riveted joints | 26-5. AutoCAD |
| 25-6. Types of riveted joints | 26-5-1. Hardware required for autocad 2009/2010 |
| 25-6-1. Lap joint | 26-5-2. Classic screen layout of autocad 2010 |
| 25-6-2. Butt joint | 26-5-3. Function keys |
| 25-7. Rolled-steel sections | 26-5-4. Drawing Entities |
| 25-7-1. Connection of plates at right angles | 26-5-5. Drafting Aids |
| 25-7-2. Gusset stay | 26-5-6. Editing of a Drawing |
| 25-8. Welded joints | 26-6. Symbol Library |
| 25-8-1. Welding | 26-7. Two dimensional drawings |
| 25-8-2. Types of welding process | 26-8. Isometric drawings |
| $25-8-3$. Types of welded and welds joints <br> (1) Types of welded joints | 26-9. 3D Geometrical Modeling |
| (2) Types of welds | 26-9-1. 3D Wireframe Modelling |
| 25-8-4. Representation of welded joints | 26-9-2. 3D Surface Modelling |
| Exercises XXV | 26-9-3. 3D Solid Modelling |
| Chapter 26 COMPUTER AIDED DRAFTING (CADr) | 26-9-4. Commands To Generate Profile Based 3D Solids |
| 26-1. Introduction | 26-10. Three Dimensional Drawings |
| 26-2. Computer Aided Drafting | 26-11. Perspective View In Autocad |
| 26-3. Computer | Exercises XXVI |

