ENGINEERING DRAWING

[PLANE AND SOLID GEOMETRY]



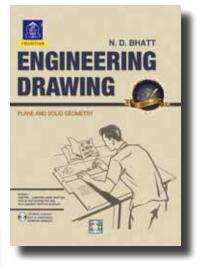
By N. D. Bhatt

Edition : 52nd Edition : 2013 ISBN : 978-93-80358-83-3 Size : 170 mm × 235 mm

Binding : Paperback with Four color Jacket Cover

Pages : 728 + 16





₹ 250.00

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:

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

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.

CONTENT

- 1 : DRAWING INSTRUMENTS AND THEIR USES
- 2 : SHEET LAYOUT AND FREE-HAND SKETCHING
- 3 : LINES, LETTERING AND DIMENSIONING
- 4 · SCALES
- 5 : GEOMETRICAL CONSTRUCTION
- 6 : CURVES USED IN ENGINEERING PRACTICE
- 7 : LOCI OF POINTS
- 8 : ORTHOGRAPHIC PROJECTION
- 9 : PROJECTIONS OF POINTS
- 10: PROJECTIONS OF STRAIGHT LINES
- 11: PROJECTIONS ON AUXILIARY PLANES
- 12: PROJECTIONS OF PLANES
- 13: PROJECTIONS OF SOLIDS
- 14: SECTIONS OF SOLIDS
- 15: DEVELOPMENT OF SURFACES
- 16: INTERSECTION OF SURFACES
- 17: ISOMETRIC PROJECTION
- 18: OBLIQUE PROJECTION
- 19: PERSPECTIVE PROJECTION
- 20: ORTHOGRAPHIC READING AND CONVERSION OF VIEWS
- 21: CENTRES OF GRAVITY AND MOMENTS OF INERTIA OF AREAS
- 22: NOMOGRAPHY
- 23: SCREW THREADS
- 24: SCREWED FASTENINGS
- 25: RIVETED JOINTS AND WELDED JOINTS
- 26 : COMPUTER AIDED DRAFTING (CADr)

INDEX

Checklist



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**

- 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
- 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
- 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
- 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
- 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
- To divide a line 5-4.
- 5-5. To divide a circle
- To bisect an angle 5-6.

- 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
 - 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
- 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
- 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
- General conclusions
 - (1) Traces
 - (2) Projections
- 12-4. Projections of planes parallel to one of the reference
 - (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



- 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
- Intersection of cone & cylinder 16-6.
- 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

19-4. Station point 23-2. Forms of screw threads 19-5. Angle of vision 23-2-1. Triangular or V threads (1) Unified thread 19-6. Picture plane (2) Metric thread Methods of drawing perspective view 19-7. (3) Whitworth thread 19-7-1. Visual-ray method (4) British Standard Fine and British Standard Pipe 19-7-2. Vanishing-point method threads 19-8. Types of perspective (5) Sellers thread (1) Parallel perspective or one point perspective (6) British Association thread (2) Angular perspective or two point perpective 23-2-2. Square thread (3) Oblique perspective or three point perspective (1) Acme thread 19-9. Distance points (2) Knuckle thread 19-10. Measuring line or line of heights (3) Buttress thread 19-11. Perspectives of circles & solids 23-3. Conventional representation of threads SP: 46-2003 23-4. Multiple-start threads 19-12. Typical problems of perspective projection 23-5. Right-hand & left-hand threads (1) Visual-ray method – by means of the top view and Exercises XXIII (2) Visual-ray method - by means of the top view and **Chapter 24 SCREWED FASTENINGS** the side view 24-0. Introduction (3) Vanishing-point method 24-1. Types of nuts 24-1-1. Hexagonal nut Exercises XIX 24-1-2. Square nut Chapter 20 ORTHOGRAPHIC READING AND 24-2. Types of nuts for special purpose **CONVERSION OF VIEWS** (1) Flanged nut 20-1. Introduction (2) Cap nut 20-2. Reading of orthographic views (Blue-print reading) (3) Dome nut 20-3. Missing lines and missing views (4) Cylindrical or capstan nut Identification of planes 20-4. (5) Ring nut 20-5. Conversion of pictorial views into orthographic views (6) Wing nut 20-6. Orthographic projection 24-3. Washers 20-7. Procedure for preparing a scale-drawing 24-4. **Bolts** 20-8. Illustrative problems 24-5. Forms of bolts Exercises XX (1) Hexagonal-headed bolt (2) Square-headed bolt **Chapter 21 CENTRES OF GRAVITY AND MOMENTS** (3) Cylindrical or cheese-headed bolt OF INERTIA OF AREAS (4) Cup-headed or round-headed bolt 21-0. Introduction (5) T-headed bolt 21-1. Centre of gravity (6) Countersunk-headed bolt 21-1-1. Centres of gravity of symmetrical areas (7) Hook bolt 21-1-2. Centres of gravity of unsymmetrical areas (8) Headless tapered bolt 21-1-3. Illustrative problems on centre of gravity (9) Eye-bolt 21-2. Moments of inertia of areas (10) Lifting eye-bolt (1) Definition, (2) Unit (11) Tap-bolt or cap-screw (3) Graphical method (12) Stud-bolt or stud 21-3. 24-6. Illustrative problems on moments of inertia Set-screws 24-7. Locking arrangements for nuts Exercises XXI (1) Lock-nut or check-nut Chapter 22 NOMOGRAPHY (2) Split-pin 22-0. Introduction (3) Slotted nut 22-1. Types of nomographs (4) Castle nut 22-2. Definitions of various terms (5) Sawn nut or Wiles nut 22-3. Principle of construction of nomographs of three variables (6) Simmond's lock-nut 22-4. Method of constructing parallel scale nomographs (7) Penn, ring or grooved nut 22-5. Layout of nomographs (8) Stop-plate or locking-plate 22-6. Z-type nomographs (9) Spring-washer **Exercises XXII** 24-8. Foundation bolts (1) Eye or Hoop bolt **Chapter 23 SCREW THREADS** (2) Rag bolt 23-0. Introduction (3) Lewis bolt 23-1. **Definitions** (4) Cotter bolt (1) Crest, (2) Root, (3) Flank, (4) Angle (5) Curved or bent bolt (5) Depth, (6) Nominal diameter (6) Squar-headed bolt (7) Outside or major diameter 24-9. Spanner (8) Core or minor diameter 24-10. Longitudinal or bar stay (9) Effective diameter 24-11. Conventional symbols for nuts and bolts (10) Pitch, (11) Lead, (12) Slope Exercises XXIV

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 Forms and proportions of rivet-heads 25-3. CAD Software 25-4. Failure of riveted joints 26-5. **AutoCAD** 25-5. Dimensions of a riveted joint 26-5-1. Hardware required for autocad 2009/2010 25-6. Types of riveted joints 26-5-2. Classic screen layout of autocad 2010 25-6-1. Lap joint 26-5-3. Function keys 25-6-2. Butt joint 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 26-9. 3D Geometrical Modeling (1) Types of welded joints 26-9-1. 3D Wireframe Modelling (2) Types of welds 26-9-2. 3D Surface Modelling 25-8-4. Representation of welded joints Exercises XXV 26-9-3. 3D Solid Modelling

Chapter 26 COMPUTER AIDED DRAFTING (CADr)

- 26-1. Introduction
- 26-2. Computer Aided Drafting
- 26-3. Computer

- 26-11. Perspective View In Autocad
 - Exercises XXVI