UNIT- I

Chapter 1 : Basic Elements of Drawing **1-1 to 1-83**

1.1 Introduction....1-2
1.2 Drawing Instruments and Supporting Material....1-2
1.2.1 Drawing Board and Drawing Table....1-3
1.2.2 T-square....1-3
1.2.3 Set Squares....1-5
1.2.4 Protractor....1-5
1.2.5 Scale....1-6
1.2.6 Roll-N-draw....1-6
1.2.7 Mini-drafter....1-6
1.2.8 Drawing Instrument Box....1-7
1.2.9 Proportional Divider....1-10
1.2.10 French Curves....1-10
1.2.11 Drafting Templates....1-11
1.2.12 Drawing Paper....1-12
1.2.13 Drawing Pencils....1-13
1.2.14 Pencil Sharpener....1-14
1.2.15 Sand-paper Block....1-14
1.2.16 Eraser and Erasing Shield....1-14
1.2.17 Duster or Handkerchief....1-14
1.2.18 Drawing Pins, Clips or Adhesive Tapes....1-14
1.2.19 Paper Box....1-15
1.2.20 Drawing Sheet Layout....1-15
1.3 Lettering....1-16
1.3.1 Freehand Lettering....1-16
1.3.2 Guidelines for Lettering....1-16
1.3.3 Single-stroke Letters....1-17
1.4 Conventions of Lines and their Applications....1-18
1.4.1 Conventions for Material Representation....1-20
1.5 Scales (Full Size, Reduced Enlarged)....1-21
1.5.1 Sizes of Scale....1-21
1.5.2 Representative Fraction (R.F.)....1-22
1.5.3 Construction of Scale....1-23
1.5.4 Some of the Important Relations for Length Measurements....1-23
1.5.5 Classification of Scales....1-23
1.5.6 Solved Example....1-25
1.6 Dimensioning....1-30
1.6.1 Systems of Dimensioning....1-31

1.6.2 Practical Hints on Dimensioning 1-34
1.7 Geometrical and Tangency Constructions 1-39
1.7.1 Drawing Perpendiculars 1-39
1.7.2 To Draw Perpendicular Bisector of a Line 1-41
1.7.3 Bisecting an Arc 1-42
1.7.4 Bisecting an Angle 1-42
1.7.5 Trisecting an Angle 1-43
1.7.6 Dividing a Line in Any Number of Equal Parts (Say Six) 1-43
1.7.7 To Divide a Given Circle into 12 Equal Parts 1-43
1.7.8 Drawing Parallel Lines 1-44
1.7.9 To Construct Equilateral Triangles 1-45
1.7.10 To Construct Squares 1-46
1.7.11 To Construct Regular Polygons 1-47
1.7.12 Some Special Methods of Drawing Regular Polygon 1-51
1.7.13 To Inscribe a Regular Octagon in a Given Square 1-54
1.7.14 To Inscribe any Regular Polygon in a Given Circle 1-55
1.7.15 To Circumscribe a Regular Polygon Around a Given Circle 1-57
1.7.16 To Find the Centre of a Given Arc 1-59
1.7.17 To Draw an Arc of a Given Radius, Touching a Given Straight Line and Passing Through a Given Point 1-60
1.7.18 To Draw an Arc of a Given Radius and Touching Two Given Straight Lines Making any Angle between them 1-60
1.7.19 To Draw an Arc of a Given Radius Touching a Given Arc and a Given Straight Line 1-61
1.7.20 To Draw an Arc of a Given Radius Touching Two Given Arcs 1-62
1.7.21 To Draw an Arc Passing Through Three Given Points not in a Straight Line 1-63
1.7.22 To Draw a Continuous Curve of Circular Arcs Passing Through any Number of Given Points not in a Straight Line 1-64
1.7.23 Drawing Tangents 1-64
1.7.24 To Determine the Length of a given Arc 1-67
1.7.25 To Determine the Length of the Circumference of a Given Circle 1-68
1.7.26 To Draw Circles and Lines in Contact 1-68
1.7.27 Inscribed circles 1-73
1.7.28 To draw in a regular polygon, the same number of equal circles as the sides of the polygon, each circle touching one side of the polygon and two of the other circles 1-74
1.7.29 To Draw in a Regular Polygon (say hexagon), the same Number of Equal Circles as the Sides of the Polygon, Each Circle Touching Two Adjacent Sides of the Polygon and Two of the Other Circles 1-75
1.7.30 To Draw in a Given Regular Hexagon, Three Equal Circles, Each Touching One Side and Two Other Circles 1-76
1.7.31 To Draw in a Given Circle, any Number of Equal Circles (Say Four) Each Touching the Given Circle and Two of the Other Circles 1-76
1.7.32 To Draw the Same Number of Equal Circles Outside a Given regular Polygon (say pentagon) , Each Circle Touching One Side and Two of the Other Circles 1-77

1.7.33 To Draw Outside a Given Circle any Number of Equal Circles (Say Six) Each Touching the Given Circle and Two Other Circles 1-77

1.7.34 To Draw a Circle Touching Two Converging Lines and Passing Trough a Given Point between Them 1-77

UNIT- II

Chapter 2 : Engineering Curves & Loci of Points **2-1 to 2-68**

2.1 Introduction 2-2

2.2 Classification of Curves 2-2

2.3 Conics 2-2

2.4 Mathematical Analysis of Conics 2-5

2.4.1 Conic Terminology 2-6

2.5 Ellipse 2-6

2.5.1 Applications of Ellipse 2-6

2.5.2 General Methods of Construction of an Ellipse 2-7

2.6 Parabola 2-13

2.6.1 Applications of Parabola 2-13

2.6.2 General Methods of Construction of a Parabola 2-14

2.7 Hyperbola 2-17

2.7.1 Applications of Hyperbola 2-17

2.7.2 General Methods of Construction of a Hyperbola 2-17

2.8 Helix 2-22

2.8.1 Applications of Helix 2-22

2.9 Involute 2-25

2.10 Cycloidal Family of Curves 2-30

2.10.1 Cycloid 2-31

2.10.2 Epicycloid 2-38

2.10.3 Hypocycloid 2-41

2.11 Archemedian Spiral 2-44

2.12 Loci of Points 2-47

2.12.1 Loci of Points Plotted According to a Certain Given Condition 2-47

2.12.2 Loci of Points in Simple Mechanisms 2-51

2.12.3 Solved Problems 2-52

UNIT- III

Chapter 3 : Orthographic Projections **3-1 to 3-49**

3.1 Introduction 3-2

3.2 Principle of Projection 3-2

3.3 Methods of Projection 3-3

3.4 Orthographic Projection....3-6
3.5 Principal Planes of Projection and Principal Views....3-6
3.5.1 System of Orthographic Projection....3-8
3.5.2 Position of Object with Respect to the Planes of Projection in Four Quadrants....3-8
3.5.3 Position of the Views on a Plane Paper when Object is Lying in Four Quadrants....3-8
3.5.4 First-Angle Projection Method....3-9
3.5.5 Third-Angle Projection Method....3-11
3.6 Analysis of Principal Lines in Principal Views....3-14
3.7 Symbols....3-14
3.8 Orthographic Views of 2D Objection....3-15
3.9 Procedure of Preparing Orthographic Views by using First-Angle Projection Method....3-17
3.10 Precedence of Lines....3-19
3.11 Method of Drawing Hidden Lines....3-20
3.12 Methods of Drawing Axis Lines....3-20
3.13 Orthographic Views of Elementary Objects....3-21
3.14 Identification of Surfaces....3-23
3.15 Fillets and Rounds....3-24
3.16 Solved Problems....3-26

UNIT- IV

Chapter 4 : Isometric Projections **4-1 to 4-55**

4.1 Introduction....4-2
4.2 Types of Pictorial Projections....4-2
4.3 Types of Axonometric Projections....4-2
4.3.1 Isometric Projection....4-3
4.3.2 Diametric Projection....4-3
4.3.3 Trimetric Projection....4-3
4.4 Isometric Projection of a Cube....4-4
4.5 Key Terms....4-4
4.6 Isometric View or Drawing and Isometric Projection....4-7
4.7 Construction of Isometric Point....4-8
4.8 Construction of Isometric Planes....4-9
4.8.1 Polygon....4-9
4.8.2 Circle and Semi-circle....4-11
4.8.3 Isometric Construction of Quarter of a Circle....4-14
4.9 Construction of Isometric Solid....4-15
4.9.1 Isometric Construction of Prism....4-16
4.9.2 Isometric Construction of Pyramid and its Frustum....4-16
4.9.3 Isometric Construction of Cylinder and Semi-Cylinder....4-17
4.9.4 Isometric Construction of Cone and its Frustum....4-20

4.9.5 Construction of Isometric Spheres 4-21
4.10 Construction of Isometric Solid Having Irregular Curve 4-23
4.11 Solved Problems 4-24
4.12 Exercise 4-45

UNIT- V

Chapter 5 : Free Hand Sketches of Engineering Elements **5-1 to 5-17**

5.1 Introduction to Fasteners 5-2
5.2 Methods of Fastening 5-2
5.2.1 Mechanical Fastening 5-2
5.2.2 Bonding 5-2
5.2.3 Forming 5-2
5.3 Screw Thread 5-2
5.4 Multiple-start Threads 5-3
5.5 Right-hand and Left-hand Threads 5-3
5.6 Conventional Representation of Threads 5-4
5.6.1 External Thread 5-4
5.6.2 Internal Thread 5-4
5.7 Forms of Screw Threads 5-4
5.8 Screwed Fasteners 5-6
5.9 Types of Nuts 5-6
5.9.1 Hexagonal Nut 5-6
5.9.2 Square Nut 5-7
5.9.3 Other Forms of Nuts 5-8
5.10 Washers 5-10
5.11 Bolts 5-10
5.12 Stud 5-12
5.13 Set-screws 5-13
5.14 Locking Arrangements for Nuts 5-14

❑❑❑