

Contents

Preface	ix
1 Descriptive Geometry Conventions	1
1.1 Descriptive Geometry History	1
1.2 Definitions	2
1.3 Abbreviations	2
1.4 Notations	3
1.5 System of Measurement	4
1.6 Space Coordination	5
1.7 Projections	5
1.8 Geometry Conventions	7
1.9 Points in Space	8
1.10 Distance between Points	9
1.11 Direction of Lines	9
1.12 Parametric Equations of Lines	10
1.13 Point and Line Definition	10
1.14 Plane Definition	11
1.15 Solid Definition	11
1.16 Point/Line/Plane Relationships	11
1.17 Point/Line/Plane Analysis	11
1.18 Measurement of Plane Surfaces	12
1.19 Planes and Solids	12
1.20 Development and Intersections	13
1.21 Chapter Problems	13
2 Point and Line Definition	14
2.1 Point and Line Relationships	14
2.2 Planes of Projection	14
2.3 Projections of a Point	15
2.4 Line of Sight for a Point	15
2.5 Location of Points	16
2.6 Lines	16
2.7 Oblique Lines	18
2.8 Principal Lines	19
2.9 Location of Lines	19
2.10 Location of Points and Lines	19
2.11 Parallel Lines	21
2.12 Parallel Projection	22

2.13	Perpendicular Lines	22
2.14	Geometric Characteristics of a Line	22
2.15	Lines Perpendicular to F or V	23
2.16	Lines Perpendicular to P	25
2.17	Lines Parallel to P Inclined to H or V	25
2.18	Lines Parallel to H Inclined to P or V	25
2.19	Lines Parallel to V Inclined to H or P	28
2.20	Lines Inclined to HVP	28
2.21	Chapter Problems	28
3	Plane Definition	29
3.1	Planes of Projection or Traces on Coordinate Planes	29
3.2	H and V Trace Intersections	31
3.3	P Trace Intersections	32
3.4	Planes Parallel to H	32
3.5	Planes Parallel to P	32
3.6	Planes Parallel to V	33
3.7	Planes Perpendicular to H and Inclined to V	34
3.8	Planes Perpendicular to V and Inclined to H	34
3.9	Plane Parallel to BL and Inclined to H and V	34
3.10	Plane Inclined to H , V and BL	34
3.11	Single Line Notation for Planes	35
3.12	Chapter Problems	36
4	Solid Definition	38
4.1	Concepts of Solid Definition	38
4.2	Information Structures for Solids	39
4.3	Solid Entities	39
4.4	Solid Generation	41
4.5	Geometric Structures	42
4.6	Primitive Structures	43
4.7	Primitive Symbols	45
4.8	Interpolative Structures	47
4.9	Arc Interpolation	50
4.10	Cubic Interpolation	52
4.11	Approximate Interpolations	52
4.12	Generative Structures	52
4.13	Special Structures	55
4.14	Point Set Structures	60
4.15	Replicative Structures	61
4.16	Topological Structures	61
4.17	Chapter Problems	61
5	Simple Point/Line/Plane Relationships	69
5.1	Determine the Projections of a Line through a Given Point	69
5.2	Determine Line Projection	70

5.3	Determine Point Projections on a Line	71
5.4	Find the <i>HVP</i> Piercing Points of a Coordinate Model	71
5.5	Display a Plane	72
5.6	Display Line in a Plane	73
5.7	Display Point in a Plane	75
5.8	Determine the Traces of a Plane Displayed by Intersecting Lines	75
5.9	Display the Traces of a Plane by Point and Line	75
5.10	Display the Traces of a Plane by Three Points	78
5.11	Display Lines Parallel to Planes	79
5.12	Display Planes Parallel to Planes	80
5.13	Display Line Parallel to Plane and Line	80
5.14	Display Line Parallel to Plane through a Point	81
5.15	Display Plane Parallel to Two Lines	81
5.16	Display Plane Parallel to Plane through a Point	84
5.17	Display Lines Perpendicular to Planes	85
5.18	Display Plane Perpendicular to Plane	85
5.19	Display Plane Perpendicular to Line	86
5.20	Determine Display Plane, Point, and Plane	89
5.21	Display Intersection of Lines	89
5.22	Display Intersection of Line and Plane	92
5.23	Display Intersection of Plane and Plane	92
5.24	Chapter Problems	95
6	Advanced Point/Line/Plane Analysis	102
6.1	Revolve a Point about a Line	102
6.2	True Length of a Line	103
6.3	Distance between a Point and a Plane	104
6.4	Distance between a Point and a Line	106
6.5	Distance between Parallel Lines	107
6.6	Distance between Parallel Planes	108
6.7	Common Perpendicular between Two Lines	110
6.8	Bisector of an Angle	110
6.9	True Size and Shape of a Plane	111
6.10	Plane Location	111
6.11	Line and Plane Location	111
6.12	Plane and Plane Location	112
6.13	Chapter Problems	114
7	Applications for Point, Line, and Plane Measurements	116
7.1	Revolve a Point about a Line	116
7.2	Angle of an Oblique Line	116
7.3	Angle between a Line and <i>BL</i>	116
7.4	Angle between Two Lines	117
7.5	Angle between Line/Plane	117

7.6	Angle between Two Planes	121
7.7	Area of a Plane	121
7.8	Volume of a Solid	121
7.9	Display Simple Solids	122
7.10	Two-Surface Solids	124
7.11	Three-Surface Solids	124
7.12	Multi-Surface Solids	126
7.13	Display Solids on Planes	126
7.14	Display Planes on Planes	127
7.15	Chapter Problems	127
8	Planes and Solids	130
8.1	Plane Classification	130
8.2	Solid Classification	130
8.3	Projection of Planes	132
8.4	Cylinders	133
8.5	Projecting Cylinders	134
8.6	Cones	134
8.7	Projecting Cones	136
8.8	Geometric Cones	136
8.9	Double-Curved Surfaces	138
8.10	Helix	138
8.11	Convolute	139
8.12	Helical Convolute	140
8.13	Helicoid	140
8.14	Hyperbolic Paraboloid	142
8.15	Conoid	142
8.16	Cylindroid	144
8.17	Hyperboloid	144
8.18	Sphere	144
8.19	Ellipsoid	146
8.20	Torus	146
8.21	Chapter Problems	146
9	Tangent Planes and Solids	148
9.1	Planes Tangent to a Solid	148
9.2	Single-Curved Surfaces	148
9.3	Tangent Planes through a Point	148
9.4	Display Construction for Cones	150
9.5	Tangent Plane/External Point	150
9.6	Tangent Plane/External Line	152
9.7	Plane/Line and Cylinder	152
9.8	Plane/Line and Angle	154
9.9	Double-Curved Surfaces	155
9.10	Tangent Plane through a Point	155

9.11	Tangent Plane/External Point	155
9.12	Chapter Problems	159
10	Intersection of Planes and Solids	162
10.1	Cutting Plane Method	162
10.2	Visibility	162
10.3	Plane and Cone	165
10.4	Plane of Intersection: Cone	165
10.5	Intersection: Cylinder	166
10.6	Intersection Angle: Cone	166
10.7	Intersection Angle: Sphere	167
10.8	Intersection: Cylinder and Cone	167
10.9	Intersection of Cylinders	172
10.10	Intersection: Equal Diameter Cylinders	172
10.11	Intersection: Unequal Diameter Cylinders	173
10.12	Angular Intersections	174
10.13	Intersection: Angular Cones and Cylinders	174
10.14	Intersection: Angular Cones and Cones	175
10.15	Chapter Problems	177
11	Development of Solid Surfaces	178
11.1	Layout Method	178
11.2	Approximation Techniques	178
11.3	Development of a Cylinder	181
11.4	Oblique Cylinder Development	181
11.5	Right Cylinder Development	182
11.6	Cone Development	182
11.7	Truncated Cone Development	185
11.8	Oblique Cone Development	185
11.9	Chapter Problems	185
12	Descriptive Geometry Applications	187
12.1	Sample Applications	187
12.2	Towards Generation Theory of Freshman Graphic Reading Error	187
12.3	Application of Multidimensional Descriptive Geometry to Phase Diagram Representation of Multicomponent Metal System	188
12.4	Proceedings of the Third International Conference on Engineering Graphics and Descriptive Geometry	189
12.5	Fundamental Ideas for Computer-Supported Descriptive Geometry	192
12.6	Localized Intersections Computation for Solid Modelling with Straight Homogeneous Generalized Cylinders	193
12.7	Graphic Interaction in Solids Modelling	193

12.8	Representation of Straight Lines by Homogeneous 6-Tuples and Geometrical Transformations	194
12.9	Fundamental Ideas for Computer-Supported Descriptive Geometry	194
12.10	The Mathematical Calculations Involved in Programming with LOGO to Derive Solutions to Descriptive Geometry Problems	194
12.11	Descriptive Geometry and Engineering Drawing Education Using CADAM	195
12.12	Combining Descriptive and Computational Geometry	195
12.13	Instructional Modules in Descriptive Geometry	196
12.14	Descriptive Geometry of the Celestial Sphere	196
12.15	Geometric Modeling of Three-Dimensional Objects in Automated Planning Systems	197
12.16	Computer Graphics and Teaching Descriptive Geometry	197
12.17	Instructional Modules in Descriptive Geometry	198
12.18	The Application of Descriptive Geometry in the Determination of the Radiation Angle Factor	198
12.19	Computer Aided Instruction of Descriptive Geometry	199
12.20	Application of Computer Graphics for Descriptive Geometry ...	199
12.21	Algorithm for Determining the Intersection of Two Simple Polyhedra	200
12.22	On the Condition of Equality between a Spatial Angle Consisting of Two Oblique Lines and its Projective Angle	200
12.23	Computer Aided Design and Descriptive Geometry for School Children	201
12.24	Constructive Geometry in Three Dimensions for Computer-Aided Design	201
12.25	On an Educational Method for Computer Graphics Introduced into Descriptive Geometry	202
12.26	Set Membership Classification: A Unified Approach to Geometric Intersection Problems	202
12.27	Descriptive Geometry—It Can Provide the Solution to Some Design Problems	203
12.28	A Microprocessor System to Help Teach Descriptive Geometry	203
12.29	Suggestions for the Application of a Plotter in Descriptive Geometry	204
12.30	Computer Exercises in Engineering Graphics	204
Index		205