

Contents

Introduction	5
1 Geometrical figures	7
1.1 Points	7
1.2 Curves	8
1.3 Surfaces	12
1.4 Solids	15
2 Planar kinematic geometry	19
2.1 Elementary and general planar motion	21
2.2 Centroides of the motion	24
2.3 Inverse motion	25
2.4 Example problems – motion given by trajectories and envelopes	26
2.5 Cyclic motions	41
2.6 Example problems – cyclic motion	44
3 Methods of projection	61
3.1 Central projection	61
3.2 Parallel projection	62
3.2.1 Monge projection	65
3.2.2 Orthogonal axonometry	67
3.2.3 Oblique projection	73
3.2.4 Construction of parallel projection of a circle	76
4 Analytic geometry	81
4.1 Vectors	81
4.2 Planar analytic geometry	82
4.2.1 Straight line in two-dimensional space	82
4.2.2 Conic sections	84
4.3 Spatial analytic geometry	90
4.3.1 Straight line in three-dimensional space	90
4.3.2 Plane	90
4.4 Mutual relationship of points, lines and planes	92
4.5 Quadratic surfaces	94
4.5.1 Sphere	95
4.5.2 Ellipsoid	95
4.5.3 Hyperboloid	96
4.5.4 Cone	99
4.5.5 Paraboloid	100

4.5.6	Cylinder	103
4.6	Example problems – analytic geometry	103
5	Surfaces of revolution and their intersections	109
5.1	Properties of surfaces of revolution	110
5.2	Example problems – surfaces of revolution	113
5.3	Intersection of surfaces of revolution	121
5.3.1	Example problems – intersection of surfaces of revolution	121
5.3.2	Degenerated intersection of two quadratic surfaces of revolution	128
6	Helicoidal surfaces	131
6.1	Properties of helix	135
6.1.1	Example problems – helix	137
6.2	Ruled helicoidal surfaces	143
6.3	Cyclic helicoidal surfaces	146
6.4	Example problems – helicoidal surfaces	148
7	Envelope surfaces	155
7.1	Types of motion	155
7.2	Properties of envelope surfaces	157
7.3	Envelope surfaces generated by motion of a plane	157
7.4	Envelope surfaces generated by motion of a sphere	159
7.5	Envelope surfaces generated by motion of a surface of revolution	161
7.6	Example problems – envelope surfaces	162
8	Developable surfaces	179
8.1	Types of developable surfaces	180
8.2	Methods of development	182
8.2.1	Example problems – developable surfaces	182
8.3	Developable transition surfaces	197
8.3.1	Problem examples – developable transition surfaces	198
	Bibliography	203