

Contents

PREFACE	7
1. INTRODUCTION	10
2. GEOMETRY: AN OUTLINE OF ITS HISTORICAL DEVELOPMENT	13
Congruence and the Euclidean group. Cartesian coordinates. Plane curves. Three dimensions. Space curves. Gaussian surface theory. Gaussian and mean curvature. Curvilinear coordinates and non-Euclidean geometry. Projective geometry. Klein's Erlangen program. Transformations.	
3. TOPOLOGICAL SPACES	38
Homeomorphisms. Polygonal symbols. Classification of surfaces.	
4. MAPPINGS	47
Submersion and immersion. Description of mappings in terms of coordinates. The design of boat hulls. Map projections. Illumination engineering. Deformations in Euclidean space. Conformal mappings in Euclidean space. Infinitesimal deformations. Time-dependent deformations.	
5. SINGULARITIES OF ANALYTIC MAPPINGS	74
Curves in two dimensions. Space curves. Scalar field in two dimensions. Mappings from two dimensions to two dimensions. Surfaces in three-space. Critical points of algebraic curves and surfaces. Envelopes. Removal of critical points and multiple points. Blum's medial axis description. Thom's catastrophe theory. Vector field in two dimensions. Vector field in three dimensions. Boundaries in fluid flow.	

6. MAPPINGS THAT ARE NOT ANALYTIC	118
Isolated exceptional points. Branch points. Lines of exceptional points. Edges and corners. Polyhedra.	
7. MINIMISING PRINCIPLES	129
Deformation of a curve. Fermat's principle. The catenary. Flexible bars and river meanders. Minimal surfaces.	
8. GENERATION OF SHAPES	136
Shape grammars. Ulam's modular patterns. Trees and river systems. Symmetry. Regular patterns in a plane. Crystallography. Tessellations and space filling. Spiral phyllotaxis. Spiral forms in three dimensions. Generation of surfaces.	
9. DISCRETE SPACES	179
Finite spaces. Graph theory. Planar graphs. Euler's formula.	
10. FITTING OF CURVES AND SURFACES	186
Interpolation. Bivariate interpolation. Coons' surface patches. Approximate methods of curve fitting. Smoothing. Surface modelling. Linear operators.	
11. THE DISCRETISED EUCLIDEAN PLANE	215
Scalar functions on a square lattice. Finite difference methods. Binary patterns. Lattice description of curves.	
12. FOURIER METHODS	230
The Fourier series. Fourier series in two dimensions. Walsh functions. The Fourier integral. Bandlimiting. The discretised Fourier transform.	
BIBLIOGRAPHY AND REFERENCES	249