

Contents

1	Introduction	1
1.1	Approximation by piecewise polynomials	1
1.2	Function spaces	11
1.3	Approximating subspaces	18
2	Variational Principles	22
2.1	Introduction	22
2.2	Stable equilibrium problems	24
2.3	Boundary conditions	27
2.4	Mixed variational principles	31
2.5	Time-dependent variational principles	32
2.6	Dual variational principles	34
3	Methods of Approximation	39
3.1	Ritz methods	39
3.2	Boundary conditions	44
3.3	The Kantorovich method	46
3.4	Galerkin methods	49
3.5	Projection method	59
4	Basis Functions	64
4.1	The Triangle	64
4.2	The Rectangle	78
4.3	The Quadrilateral	81
4.4	The Tetrahedron	86
4.5	The Hexahedron	89
4.6	Curved boundaries	90
5	Convergence of Approximation	103
5.1	Introduction	103
5.2	Convergence of Galerkin approximations	113
5.3	Approximation errors	117
5.4	Perturbation errors	123
5.5	Summary	139

6 Time-Dependent Problems	143
6.1 Hamilton's Principle	143
6.2 Dissipative systems	148
6.3 Semi-discrete Galerkin methods	150
6.4 Continuous methods in time	156
6.5 Discretization in time	158
6.6 Convergence of semi-discrete Galerkin approximations	163
7 Developments and Applications	166
7.1 Introduction	166
7.2 Non-conforming elements	167
7.3 Blending function interpolants	174
7.4 Applications	176
References	191
Index	196

