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Nota di contenuto	Cover; Contents; 1 Historical introduction; 2 Weighted residual and variational methods; 2.1 Classification of differential operators; 2.2 Self-adjoint positive definite operators; 2.3 Weighted residual methods; 2.4 Extremum formulation: homogeneous boundary conditions; 2.5 Non-homogeneous boundary conditions; 2.6 Partial differential equations: natural boundary conditions; 2.7 The Rayleigh-Ritz method; 2.8 The 'elastic analogy' for Poisson's equation; 2.9 Variational methods for time-dependent problems; 2.10 Exercises and solutions; 3 The finite element method for elliptic problems 3.1 Difficulties associated with the application of weighted residual methods3.2 Piecewise application of the Galerkin method; 3.3 Terminology; 3.4 Finite element idealization; 3.5 Illustrative problem involving one independent variable; 3.6 Finite element equations for Poisson's equation; 3.7 A rectangular element for Poisson's equation; 3.8 A triangular element for Poisson's equation; 3.9 Exercises and solutions; 4 Higher-order elements: the isoparametric concept; 4.1 A two-point boundary-value problem; 4.2 Higher-order rectangular elements; 4.3 Higher-order triangular elements 4.4 Two degrees of freedom at each node4.5 Condensation of internal

nodal freedoms; 4.6 Curved boundaries and higher-order elements: isoparametric elements; 4.7 Exercises and solutions; 5 Further topics in the finite element method; 5.1 The variational approach; 5.2 Collocation and least squares methods; 5.3 Use of Galerkin's method for time-dependent and non-linear problems; 5.4 Time-dependent problems using variational principles which are not extremal; 5.5 The Laplace transform; 5.6 Exercises and solutions; 6 Convergence of the finite element method; 6.1 A one-dimensional example
6.2 Two-dimensional problems involving Poisson's equation6.3 Isoparametric elements: numerical integration; 6.4 Non-conforming elements: the patch test; 6.5 Comparison with the finite difference method: stability; 6.6 Exercises and solutions; 7 The boundary element method; 7.1 Integral formulation of boundary-value problems; 7.2 Boundary element idealization for Laplace's equation; 7.3 A constant boundary element for Laplace's equation; 7.4 A linear element for Laplace's equation; 7.5 Time-dependent problems; 7.6 Exercises and solutions; 8 Computational aspects; 8.1 Pre-processor
8.2 Solution phase8.3 Post-processor; 8.4 Finite element method (FEM) or boundary element method (BEM)?; Appendix A: Partial differential equation models in the physical sciences; A.1 Parabolic problems; A.2 Elliptic problems; A.3 Hyperbolic problems; A.4 Initial and boundary conditions; Appendix B: Some integral theorems of the vector calculus; Appendix C: A formula for integrating products of area coordinates over a triangle; Appendix D: Numerical integration formulae; D.1 One-dimensional Gauss quadrature; D.2 Two-dimensional Gauss quadrature; D.3 Logarithmic Gauss quadrature
Appendix E: Stehfest's formula and weights for numerical Laplace transform inversion

Sommario/riassunto

The finite element method is a technique for solving problems in applied science and engineering. The essence of this book is the application of the finite element method to the solution of boundary and initial-value problems posed in terms of partial differential equations. The method is developed for the solution of Poisson's equation, in a weighted-residual context, and then proceeds to time-dependent and nonlinear problems. The relationship with the variational approach is alsoexplained. This book is written at an introductory level, developing all the necessary concepts where required. Co