

Elliptic Differential Equations: Theory and Numerical Treatment (Springer Series in Computational Mathematics)

By Wolfgang Hackbusch

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This book has developed from lectures that the author gave for mathematics students at the Ruhr-Universitat Bochum and the Christian-Albrechts-Uni versitat Kiel. This edition is the result of the translation and correction of the German edition entitled Theone und Numenk elliptischer Differential gleichungen. The present work is restricted to the theory of partial differential equa tions of elliptic type, which otherwise tends to be given a treatment which is either too superficial or too extensive. The following sketch shows what the problems are for elliptic differential equations. A: Theory of B: Discretisation: c: Numerical analysis elliptic Difference Methods, convergence, equations finite elements, etc. stability Elliptic Discrete boundary value equations f-------- ----- problems E:Theory of D: Equation solution: iteration Direct or with methods iteration methods The theory of elliptic differential equations (A) is concerned with ques tions of existence, uniqueness, and properties of solutions. The first problem of VI Foreword numerical treatment is the description of the discretisation procedures (B), which give finite-dimensional equations for approximations to the solu tions. The subsequent second part of the numerical treatment is numerical analysis (0) of the procedure in question. In particular it is necessary to find out if, and how fast, the approximation converges to the exact solution.

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Editorial Review

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From the Back Cover

This book simultaneously presents the theory and the numerical treatment of elliptic boundary value problems, since an understanding of the theory is necessary for the numerical analysis of the discretisation. It first discusses the Laplace equation and its finite difference discretisation before addressing the general linear differential equation of second order. The variational formulation together with the necessary background from functional analysis provides the basis for the Galerkin and finite-element methods, which are explored in detail. A more advanced chapter leads the reader to the theory of regularity. Individual chapters are devoted to singularly perturbed as well as to elliptic eigenvalue problems. The book also presents the Stokes problem and its discretisation as an example of a saddle-point problem taking into account its relevance to applications in fluid dynamics.

About the Author
The author is a very well-known author of Springer, working in the field of numerical mathematics for partial differential equations and integral equations. He has published numerous books in the SSCM series, e.g., about the multi-grid method, about the numerical analysis of elliptic pdes, about iterative solution of large systems of equation, and a book in German about the technique of hierarchical matrices. Hackbusch is member of the editorial board of Springer' s book series "Advances in Numerical Mathematics", "The International Cryogenics Monograph Series" and "Springer Series of Computational Mathematics".

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