A First Course in Ordinary Differential Equations: Analytical and Numerical Methods

By Martin Hermann, Masoud Saravi

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This book presents a modern introduction to analytical and numerical techniques for solving ordinary differential equations (ODEs). Contrary to the traditional format?the theorem-and-proof format?the book is focusing on analytical and numerical methods. The book supplies a variety of problems and examples, ranging from the elementary to the advanced level, to introduce and study the mathematics of ODEs. The analytical part of the book deals with solution techniques for scalar first-order and second-order linear ODEs, and systems of linear ODEs?with a special focus on the Laplace transform, operator techniques and power series solutions. In the numerical part, theoretical and practical aspects of Runge-Kutta methods for solving initial-value problems and shooting methods for linear two-point boundary-value problems are considered.

The book is intended as a primary text for courses on the theory of ODEs and numerical treatment of ODEs for advanced undergraduate and early graduate students. It is assumed that the reader has a basic grasp of elementary calculus, in particular methods of integration, and of numerical analysis. Physicists, chemists, biologists, computer scientists and engineers whose work involves solving ODEs will also find the book useful as a reference work and tool for independent study. The book has been prepared within the framework of a German–Iranian research project on mathematical methods for ODEs, which was started in early 2012.

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A First Course in Ordinary Differential Equations: Analytical and Numerical Methods By Martin Hermann, Masoud Saravi Bibliography

- Rank: #5549761 in Books
- Published on: 2014-04-23
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .69" w x 6.14" l, 1.36 pounds
- Binding: Hardcover
- 288 pages

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Editorial Review

From the Back Cover

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About the Author

MARTIN HERMANN is Professor of Numerical Mathematics at the Friedrich Schiller University (FSU) Jena (Germany). His activities and research interests are in the field of scientific computing and numerical analysis of nonlinear parameter-dependent ordinary differential equations (ODEs). He is also the founder of the Interdisciplinary Centre for Scientific Computing (1999), where scientists of different faculties at the FSU Jena work together in the fields of applied mathematics, computer sciences and applications. Since 2003, he has headed an international collaborative project with the Institute of Mathematics at the National Academy of Sciences Kiev (Ukraine), studying e.g. the sloshing of liquids in tanks. Since 2003, Dr. Hermann has been a curator at the Collegium Europaeum Jenense of the FSU Jena (CEJ) and the first chairman of the Friends of the CEJ. In addition to his professional activities, he volunteers in various organizations and associations. In German-speaking countries, his books *Numerical Mathematics* and *Numerical Treatment of ODEs: Initial and Boundary Value Problems* count among the standard works on numerical analysis. He has also produced over 70 articles for refereed journals.

MASOUD SARAVI is Professor of Mathematics at the Islamic Azad University (IAU), Nour Branch, Iran. His research interests include the numerical solution of ODEs, partial differential equations (PDEs) and integral equations, as well as differential algebraic equations (DAE) and spectral methods. In addition to publishing several papers with German colleagues, Dr. Saravi has published more than 15 successful titles on mathematics. The immense popularity of his books is deemed as a reflection of more than 20 years of educational experience, and a result of his accessible style of writing, as well as a broad coverage of well laid-out and easy-to-follow subjects. He is currently a board member at the IAU and is working together with the Numerical Analysis Group and the Faculty of Mathematics and Computer Sciences of FSU Jena (Germany). He started off his academic studies at UK's Dudley Technical College before receiving his first degree in mathematics and statistics from the Polytechnic of North London, and his advanced degree in numerical analysis from Brunel University. After obtaining his M.Phil. in applied mathematics from Iran's

Amir Kabir University, he completed his Ph.D. in numerical analysis on solutions of ODEs and DAEs using spectral methods at the UK's Open University.

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