FOREWORD

Exact solutions of differential equations play an important role in the proper understanding of qualitative features of many phenomena and processes in various areas of natural science. These solutions can be used to verify the consistencies and estimate errors of various numerical, asymptotic, and approximate analytical methods.

This book contains nearly 6200 ordinary differential equations and their solutions. A number of new solutions to nonlinear equations are described. In some sections of this book, asymptotic solutions to some classes of equations are also given.

When selecting the material, the authors gave preference to the following two types of equations:

- Equations that have traditionally attracted the attention of many researchers: those of the simplest appearance but involving the most difficulties for integration (Abel equations, Emden–Fowler equations, Painlevé equations, etc.)
- Equations that are encountered in various applications (in the theory of heat and mass transfer, nonlinear mechanics, elasticity, hydrodynamics, theory of nonlinear oscillations, combustion theory, chemical engineering science, etc.)

Special attention is paid to equations that depend on arbitrary functions. All other equations contain one or more arbitrary parameters (in fact, this book deals with whole families of ordinary differential equations), which can be fixed by a reader at will. In total, the handbook contains many more equations than any other book currently available (for example, the number of nonlinear equations of the second and higher order is ten times more than in the well-known E. Kamke's *Handbook on Ordinary Differential Equations*).

For the reader's convenience, the introductory chapter of the book outlines basic definitions, useful formulas, and some transformations. In a concise form, it also presents exact, asymptotic, and approximate analytical methods for solving linear and nonlinear differential equations. Specific examples of utilization of these methods are considered. Formulations of existence and uniqueness theorems are also given. Boundary-value problems and eigenvalue problems are described.

The handbook consists of chapters, sections, subsections, and paragraphs. Equations and formulas are numbered separately in each subsection. The equations within subsections and paragraphs are arranged in increasing order of complexity. The extensive table of contents provides rapid access to the desired equations.

The main material is followed by some supplements, where basic properties of elementary and special functions (Bessel, modified Bessel, hypergeometric, Legendre, etc.) are described.

Here are *three main distinguishing features of the second edition vs. the first edition*:

- 1200 nonlinear equations with solutions have been added.
- An introductory chapter that outlines exact, asymptotic, and approximate analytical methods for solving ordinary differential equations has been included.
- The overwhelming majority of subsections are organized into paragraphs. As a result, the table of contents has been increased threefold to help the readers get faster access to desired equations.

We would like to express our deep gratitude to Alexei Zhurov for fruitful discussions and valuable remarks. We are very grateful to Alain Moussiaux who tested a number of solutions, which allowed us to remove some inaccuracies and misprints.

The authors hope that this book will be helpful for a wide range of scientists, university teachers, engineers, and students engaged in the fields of mathematics, physics, mechanics, control, chemistry, and engineering sciences.

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