PREFACE

First order partial differential equations are encountered in various fields of science and numerous applications (differential geometry, analytical mechanics, solid mechanics, gas dynamics, geometric optics, wave theory, heat and mass transfer, multiphase flows, control theory, differential games, calculus of variations, dynamic programming, chemical engineering sciences, etc.).

Exact (closed-form) 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. They can be used to verify the consistency and estimate errors of various numerical, asymptotic, and approximate methods.

The book contains about 3000 first order partial differential equations with solutions. A lot of new exact solutions to linear and nonlinear equations are included (a large portion of these solutions was constructed by "recalculating" the corresponding results obtained by the authors over the last decade in the field of ordinary differential equations). Special attention is paid to equations of general form which depend on arbitrary functions. Other equations contain one or more free parameters (the book actually deals with families of differential equations); it is the reader's option to fix these parameters. A number of differential equations are considered which are encountered in various fields of applied mathematics, mechanics, physics, control theory, and engineering sciences. Totally, the number of equations described is several times greater than in any other book available.

The handbook consists of chapters, sections, and subsections. The equations within a subsection are arranged in the increasing order of complexity. An extensive table of contents provides rapid access to the desired equations.

Each chapter opens with a "Preliminary Remarks" section, which briefly outlines basic analytical methods for solving the corresponding types of differential equations and presents specific examples. Both classical (smooth) and generalized (nonsmooth, discontinuous) solutions of the Cauchy problem for nonlinear equations are considered. To meet the demands of a wider readership with diverse mathematical backgrounds, the authors tried to avoid the use of special terminology wherever possible. Therefore, some of the methods are outlined in a schematic and somewhat simplified manner, with necessary references made to books where these methods are considered in more detail.

The main material is followed by a supplement which presents CONVODE, a specialized software package for solving ordinary differential equations and first order partial differential equations analytically. The reader can get access to CONVODE via e-mail.

We would like to express our deep gratitude to Dr. Alexei Zhurov for useful remarks and invaluable help in preparing the camera-ready copy of the book and to Prof. Arik Melikyan for fruitful discussion of Sections 14.1 and 15.1. We also thank Richard Mairesse of the FUNDP computing center for helpful comments, maintaning Reduce, and more.

The authors hope that the handbook will prove helpful for a wide readership of researchers, college and university teachers, engineers, and students in various fields of applied mathematics, mechanics, physics, optimal control, differential games, and engineering sciences.

Andrei D. Polyanin
Valentin F. Zaitsev
Alain Moussiaux