

AN INTRODUCTION TO



DIFFERENTIAL EQUATIONS

with Difference Equations, Fourier Analysis, and Partial Differential Equations

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3.3.86

An Introduction to Differential Equations

*with Difference Equations, Fourier Series,
and Partial Differential Equations*

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Wadsworth Publishing Company
Belmont, California

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List of Applications

Each entry in this list is coded according to whether the application appears in detail (A), little or no detail (B) or is an exercise or example associated with an application (C).

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Preface

This book is designed for an introductory, one-semester or one-year course in differential equations, both ordinary and partial. Its prerequisite is elementary calculus.

Perusal of the table of contents and the list of applications shows that the book contains the theory, techniques, and applications covered in the traditional introductory courses in differential equations. A major feature of this text is the quantity and variety of applications of current interest in physical, biological, and social sciences. We have furnished a wealth of applications from such diverse fields as astronomy, bioengineering, biology, botany, chemistry, ecology, economics, electric circuits, finance, geometry, mechanics, medicine, meteorology, pharmacology, physics, psychology, seismology, sociology, and statistics.

Our experience gained in teaching differential equations at the elementary, intermediate, and graduate levels at the University of Rhode Island convinced us of the need for a book at the elementary level which emphasizes to the students the relevance of the various equations to which they are exposed in the course. That is to say that the various types of differential equations encountered are not merely the product of some mathematician's imagination but rather that the equations occur in the course of scientific investigations of real-world phenomena.

The goal of this book, then, is to make elementary differential equations more useful, more meaningful, and more exciting to the student. To accomplish this, we strive to demonstrate that differential equations are very much "alive" in present-day applications. This approach has indeed had a satisfying effect in the courses we have taught recently.

During the preparation and class testing of this text we continuously kept in mind both the student and the teacher. We have tried to make the presentation direct, yet informal. Definitions and theorems are stated precisely and rigorously, but theory and rigor have been minimized in favor of comprehension of technique. The general approach is to use a larger number of routine examples to illustrate the new concepts, definitions, methods of solution, and theorems. Thus, it is intended that the material will be easily accessible to the student. Hopefully the presence of modern applications in addition to the traditional applications of geometry, physics, and chemistry will be refreshing to the teacher.

Numerous routine exercises in each section will help to test and strengthen the student's understanding of the new methods under discussion. There are over 1600 exercises in the text with answers to odd-numbered exercises pro-