

Preface to the Third Edition

The goal of this new edition is the same as that for the original, namely, to present a one-semester treatment of the basic ideas encountered in partial differential equations (PDEs). The text is designed for a 3-credit semester course for undergraduate students in mathematics, science, and engineering. The prerequisites are calculus and ordinary differential equations. The text is intimately tied to applications in heat conduction, wave motion, biological systems, and a variety of other topics in pure and applied science. Therefore, students should have some interest, or experience, in basic science or engineering.

The main part of the text is the first four chapters, which cover the essential concepts. Specifically, they treat first- and second-order equations on bounded and unbounded domains and include transform methods (Laplace and Fourier), characteristic methods, and eigenfunction expansions (separation of variables); there is considerable material on the origin of PDEs in the natural sciences and engineering. Two additional chapters, Chapter 5 and Chapter 6, are short introductions to applications of PDEs in biology and to numerical computation of solutions. The text offers flexibility to instructors who, for example, may want to insert topics from biology or numerical methods at any time in the course. A brief appendix reviews techniques from ordinary differential equations. Sections marked with an asterisk (*) may safely be omitted. The mathematical ideas are strongly motivated by physical problems, and the exposition is presented in a concise style accessible to students in science and engineering. The emphasis is on motivation, methods, concepts, and interpretation rather than formal theory.

The level of exposition is slightly higher than students encounter in the post-calculus differential equations course. The philosophy is that a student should progress in the ability to read mathematics. Elementary texts contain

many examples and detailed calculations, but advanced mathematics and science books leave a lot to the reader. This text leaves some of the easy details to the reader. Often, the arguments are derivations in lieu of carefully constructed proofs. The exercises are at varying levels and encourage students to think about the concepts and derivations rather than just grind out lots of routine solutions. A student who reads this book carefully and who solves many of the exercises will have a sound knowledge base to continue with a second-year partial differential equations course where careful proofs are constructed or with upper-division courses in science and engineering where detailed, and often difficult, applications of partial differential equations are introduced.

This third edition, a substantial revision, contains many new and revised exercises, and some sections have been greatly expanded with more worked examples and additional explanatory material. A new, less dense, format makes key results more apparent and the text easier to read for undergraduates. The result is a text one-third longer. But the size and brevity of text, contrary to voluminous other texts, struck a chord with many users and that has been maintained. Many users provided suggestions that have become part of this revision, and I greatly appreciate their interest and comments.

Elizabeth Loew, my editor at Springer, deserves special recognition for her continuous and expert support. I have found Springer to be an extraordinary partner in this project.

Finally, this book is very affectionately dedicated to my two sons and daughter, Aaron, David, and Rachel, who have often been my teachers with their challenging and unique perspectives on life. For these gifts I greatly thank you.

I welcome suggestions, comments, and corrections. Contact information is on my web site: <http://www.math.unl.edu/~jlogan1>, where additional items can be found. Solutions to some of the exercises can be found on the Springer web site.

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