**A Student's Guide to Waves**

Waves are an important topic in the fields of mechanics, electromagnetism, and quantum theory, but many students struggle with the mathematical aspects. Written to complement course textbooks, this book focuses on the topics that students find most difficult.

Retaining the highly popular approach used in Fleisch's other Student's Guides, the book uses plain language to explain fundamental ideas in a simple and clear way. Exercises and fully worked examples help readers test their understanding of the concepts, making this an ideal book for undergraduates in physics and engineering trying to get to grips with this challenging subject.

The book is supported by a suite of online resources available at www.cambridge.org/wavesguide. These include interactive solutions for every exercise and problem in the text and a series of podcasts in which the authors explain the important concepts of every section of the book.

DANIEL FLEISCH is a Professor in the Department of Physics at Wittenberg University, where he specializes in electromagnetics and space physics. He is the author of several Student's Guide books, including most recently *A Student's Guide to the Mathematics of Astronomy* (Cambridge University Press, 2013).

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# A Student's Guide to Waves

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# Preface

This book has one purpose: to help you understand the foundational concepts of waves and the mathematics of the wave equation. The authors have attempted to fill the book with clear, plain-language explanations, using just enough mathematical rigor to help you understand the important principles without obscuring the underlying physics. Armed with that understanding, you'll be ready to tackle the many excellent texts that deal with mechanical, electromagnetic, and quantum waves.

You should understand that this book is meant to be used as a supplemental text and is not intended to be a comprehensive treatment of wave phenomena. That means that we haven't attempted to cover every aspect of waves; instead, we've included the topics that our students have found most troubling.

As you'll see, the design of the book supports its use as a supplemental text. Whenever possible, we've made the chapters modular, allowing you to skip material you've already mastered so you can proceed directly to the topics with which you need help. As a Student's Guide, this book is accompanied by a website that provides a variety of freely available material that we think you'll find very helpful. That includes complete, interactive solutions to every problem in the book, as well as a series of podcasts in which we explain the most important concepts, equations, and graphs in every section of every chapter. By "interactive" we mean that you can see the full solution immediately, or you can request one or more hints that will guide you to the final solution. The icon  appears throughout the book and highlights where there is accompanying material available online. If you choose to read the ebook on a device that supports interactivity, these additional features will appear directly within the text. If your device doesn't support interactivity, clicking on  will take you straight to the books website.

Is this book right for you? It is if you're looking for help in understanding waves, whether you need that help to supplement your work in a physics or engineering class, in preparing for the physical science portion of a standard exam, or as a part of a program of self-study. Whatever your reason, we commend your initiative.

# Acknowledgements

Primary responsibility for the good bits in this book belongs to the students in our classes, whose curiosity, intelligence, and persistence have inspired us to pursue (and occasionally find) deeper understanding and better explanations of the physics of waves. We thank those students.

We also thank Dr. Nick Gibbons, Dr. Simon Capelin, and the world-class production team of Cambridge University Press, whose support has been essential during the two-year process that has resulted in this book. The e-book version of this text would not have been possible without the thoughtful guidance of Claire Eudall and Catherine Flack.

Laura also thanks her sister, Dr. Carrie Miller, for all of the feedback, support, and encouragement that she's given. I can always count on Carrie to help me see my way out of a tricky spot. I also thank Bennett for his patience and support when I hole myself up, writing. My parents, sisters, brothers-in-law, nieces, and nephews who all provided encouragement and diversion, thank you!

And as always, Dan thanks Jill for her unwavering support and acknowledges the foresight and intuition of Dr. John Fowler, who made possible my contributions to the Cambridge line of *Student's Guides*.