Preface

APPROACH This text is designed for students in mathematics, physics, and engineering at the junior or senior undergraduate level. The necessary theoretical concepts and proofs are illustrated with practical applications and are presented in a style that is enjoyable for students to read. We believe both mathematicians and scientists should be exposed to a careful presentation of mathematics. Our use of the term "careful" here means paying attention to such things as ensuring required assumptions are met before using a theorem, checking that algebraic operations are valid, and confirming that formulas have not been blindly applied. We do not mean to equate care with rigor, as we present our proofs in a self-contained manner that is understandable by students who have a sophomore calculus background. For example, we include Green's theorem and use it to prove the Cauchy–Goursat theorem, although we also include the proof by Goursat. Depending on the level of rigor desired, students may look at one or the other—or both.

We give sufficient applications to motivate and illustrate how complex analysis is used in applied fields. For example, this sixth edition has an improved chapter on Fourier and Laplace transforms. Computer graphics help show that complex analysis is a computational tool of practical value. The exercise sets offer a wide variety of choices for computational skills, theoretical understanding, and applications that have been class tested for five prior editions of the text. We provide answers to all odd-numbered problems. For those problems that require proofs, we attempt to model what a good proof should look like, often guiding students up to a point and then asking them to fill in the details.

The purpose of the first six chapters is to lay the foundation for the study of complex analysis and develop the topics of analytic and harmonic functions, the elementary functions, and contour integration. This sixth edition includes an updated historical introduction to the field in Chapter 1. Chapters 7 and 8, dealing with residue calculus and applications, may be skipped if there is more interest in conformal mapping and applications of harmonic functions, which are the topics of Chapters 10 and 11, respectively. For courses requiring even more applications, Chapter 12 investigates Fourier and Laplace transforms. Chapter 9 covers the z-transform. It also gives a peek at digital filter design and signal processing, though the residue theory of Chapter 8 is a prerequisite.

FEATURES With feedback from students in both university and college settings, a good amount of textual material and problem statements has been rewritten or reorganized. The two-color setting of this new edition has been maintained for ease of reading. The answers to all odd-numbered exercises should help instructors as they deliberate on problem assignments, and should help students as they review material. We present conformal mapping in a visual and geometric manner so that compositions and images of curves and regions can be more easily understood. We first solve boundary value problems for harmonic functions in the upper half-plane so that we can use conformal mapping by elementary functions to obtain solutions in other domains. We carefully develop the Schwarz–Christoffel transformation and present applications. Two-dimensional mathematical models are used for applications in the areas of ideal fluid flow, steady-state temperatures, and electrostatics. We accurately portray streamlines, isothermals, and equipotential curves with computer-drawn figures.

An early introduction to sequences and series appears in Chapter 4 and facilitates the definition of the exponential function via series. We include a section on Julia and Mandelbrot sets, showing how complex analysis is connected to contemporary topics in mathematics. We keep in place the modern computer-generated illustrations introduced in earlier editions, including Riemann surfaces, contour and surface graphics for harmonic functions, the Dirichlet problem, streamlines involving harmonic and analytic functions, and conformal mapping. We also include a section on the Joukowski airfoil.

The website http://www.jblearning.com/catalog/9781449604455/ contains supplementary materials for both PC and Macintosh® computers using the software products Maple™, and *Mathematica*®. Additional important materials, such as *Mathematica* notebooks and graphical enhancements to the exercises, can be found on the authors' website: http://math.fullerton.edu/mathews/complex.html.

We support the emphasis currently being placed in undergraduate research. To help in this effort we have prepared a rather extensive list of research projects for students. They are listed on the Jones & Bartlett Learning website for this book, given above.

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Finally, we thank in advance those of you who will make suggestions for improvements to the text as it now stands. We welcome correspondence via surface or email as well as visits to our website, http://math.fullerton.edu/mathews/complex.html.

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