Preface

This book deals with aspects of mathematical techniques and models that constitute an important part of the foundation for the analysis of linear systems. The subject is classical and forms a significant component of linear systems theory. These include Fourier, Z-transforms, Laplace, and related transforms both in their continuous and discrete versions. The subject is an integral part of electrical engineering curricula and is covered in many excellent textbooks. In light of this, an additional book dealing with the same topics would appear superfluous. What distinguishes this book is that the same topics are viewed from a distinctly different perspective. Rather than dealing with different transforms essentially in isolation, a methodology is developed that unifies the classical portion of the subject and permits the inclusion of topics that usually are not considered part of the linear systems theory. The unifying principle here is the least mean square approximation, the normal equations, and their extensions to the continuum. This approach gives equal status to expansions in terms of special functions (that need not be orthogonal), Fourier series, Fourier integrals, and discrete transforms. As a by-product one also gains new insights. For example, the Gibbs phenomenon is a general property of LMS convergence at step discontinuities and is not limited to Fourier series.

This book is suitable for a first year graduate course that provides a transition from the level the subject is presented in an undergraduate course in signals and systems to a level more appropriate as a prerequisite for graduate work in specialized fields. The material presented here is based in part on the notes used for a similar course taught by the author in the School of Electrical and Computer Engineering at The George Washington University. The six chapters can be covered in one semester with sufficient flexibility in the choice of topics within each chapter. The exception is Chap. 1 which, in the spirit of the intended unity, sets the stage for the remainder of the book. It includes the mathematical foundation and the methodology applied in the chapters to follow.

The prerequisites for the course are an undergraduate course in signals and systems, elements of linear algebra, and the theory of functions of a complex variable. Recognizing that frequently the preparation, if any, in the latter is sketchy, the necessary material is presented in the Appendix.

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