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Hwei Hsu, Ph.D.

Signals and Systems

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Hwei P. Hsu, Ph.D.

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Preface to The Second Edition

The purpose of this book, like its previous edition, is to provide the concepts and theory of signals and systems needed in almost all electrical engineering fields and in many other engineering and science disciplines as well.

In the previous edition the book focused strictly on deterministic signals and systems. This new edition expands the contents of the first edition by adding two chapters dealing with random signals and the response of linear systems to random inputs. The background material on probability needed for these two chapters is included in Appendix B.

I wish to express my appreciation to Ms. Kimberly Eaton and Mr. Charles Wall of the McGraw-Hill Schaum Series for inviting me to revise the book.

HWEI P. HSU
Shannondell at Valley Forge, Audubon, Pennsylvania

Preface to The First Edition

The concepts and theory of signals and systems are needed in almost all electrical engineering fields and in many other engineering and scientific disciplines as well. They form the foundation for further studies in areas such as communication, signal processing, and control systems.

This book is intended to be used as a supplement to all textbooks on signals and systems or for self-study. It may also be used as a textbook in its own right. Each topic is introduced in a chapter with numerous solved problems. The solved problems constitute an integral part of the text.

Chapter 1 introduces the mathematical description and representation of both continuous-time and discrete-time signals and systems. Chapter 2 develops the fundamental input-output relationship for linear time-invariant (LTI) systems and explains the unit impulse response of the system and convolution operation. Chapters 3 and 4 explore the transform techniques for the analysis of LTI systems. The Laplace transform and its application to continuous-time LTI systems are considered in Chapter 3. Chapter 4 deals with the z-transform and its application to discrete-time LTI systems. The Fourier analysis of signals and systems is treated in Chapters 5 and 6. Chapter 5 considers the Fourier analysis of continuous-time signals and systems, while Chapter 6 deals with discrete-time signals and systems. The final chapter, Chapter 7, presents the state space or state variable concept and analysis for both discrete-time and continuous-time systems. In addition, background material on matrix analysis needed for Chapter 7 is included in Appendix A.

I am grateful to Professor Gordon Silverman of Manhattan College for his assistance, comments, and careful review of the manuscript. I also wish to thank the staff of the McGraw-Hill Schaum Series, especially John Aliano for his helpful comments and suggestions and Maureen Walker for her great care in preparing this book. Last, I am indebted to my wife, Daisy, whose understanding and constant support were necessary factors in the completion of this work.

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To the Student

To understand the material in this text, the reader is assumed to have a basic knowledge of calculus, along with some knowledge of differential equations and the first circuit course in electrical engineering.

This text covers both continuous-time and discrete-time signals and systems. If the course you are taking covers only continuous-time signals and systems, you may study parts of Chapters 1 and 2 covering the continuous-time case, Chapters 3 and 5, and the second part of Chapter 7. If the course you are taking covers only discrete-time signals and systems, you may study parts of Chapters 1 and 2 covering the discrete-time case, Chapters 4 and 6, and the first part of Chapter 7.

To really master a subject, a continuous interplay between skills and knowledge must take place. By studying and reviewing many solved problems and seeing how each problem is approached and how it is solved, you can learn the skills of solving problems easily and increase your store of necessary knowledge. Then, to test and reinforce your learned skills, it is imperative that you work out the supplementary problems (hints and answers are provided). I would like to emphasize that there is no short cut to learning except by "doing."

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