

Preface

This text, like its previous three editions, is an introduction to communication systems written at a level appropriate for advanced undergraduates and first-year graduate students in electrical or computer engineering. New features in this edition include the introduction of two other authors, Professors Rutledge and Crilly, to provide additional expertise for topics such as optical links and spread spectrum.

An initial study of signal transmission and the inherent limitations of physical systems establishes unifying concepts of communication. Attention is then given to analog communication systems, random signals and noise, digital systems, and information theory. However, as indicated in the table of contents, instructors may choose to skip over topics that have already been or will be covered elsewhere.

Mathematical techniques and models necessarily play an important role throughout the book, but always in the engineering context as means to an end. Numerous applications have been incorporated for their practical significance and as illustrations of concepts and design strategies. Some hardware considerations are also included to justify various communication methods, to stimulate interest, and to bring out connections with other branches of the field.

PREREQUISITE BACKGROUND

The assumed background is equivalent to the first two or three years of an electrical or computer engineering curriculum. Essential prerequisites are differential equations, steady-state and transient circuit analysis, and a first course in electronics. Students should also have some familiarity with operational amplifiers, digital logic, and matrix notation. Helpful but not required are prior exposure to linear systems analysis, Fourier transforms, and probability theory.

CONTENTS AND ORGANIZATION

A distinctive feature of this edition is the position and treatment of probability, random signals, and noise. These topics are located after the discussion of analog systems without noise. Other distinctive features are the new chapter on spread spectrum systems and the revised chapter on information and detection theory near the end of the book. The specific topics are listed in the table of contents and discussed further in Sect. 1.4.

Following an updated introductory chapter, this text has two chapters dealing with basic tools. These tools are then applied in the next four chapters to analog communication systems, including sampling and pulse modulation. Probability, random signals, and noise are introduced in the following three chapters and applied to analog systems. An appendix separately covers circuit and system noise. The remaining

six chapters are devoted to digital communication and information theory, which require some knowledge of random signals and include coded pulse modulation.

All sixteen chapters can be presented in a year-long undergraduate course with minimum prerequisites. Or a one-term undergraduate course on analog communication might consist of material in the first seven chapters. If linear systems and probability theory are covered in prerequisite courses, then most of the last eight chapters can be included in a one-term senior/graduate course devoted primarily to digital communication.

The modular chapter structure allows considerable latitude for other formats. As a guide to topic selection, the table of contents indicates the minimum prerequisites for each chapter section. Optional topics within chapters are marked by the symbol ★.

INSTRUCTIONAL AIDS

Each chapter after the first one includes a list of instructional objectives to guide student study. Subsequent chapters also contain several examples and exercises. The exercises are designed to help students master their grasp of new material presented in the text, and exercise solutions are given at the back. The examples have been chosen to illuminate concepts and techniques that students often find troublesome.

Problems at the ends of chapters are numbered by text section. They range from basic manipulations and computations to more advanced analysis and design tasks. A manual of problem solutions is available to instructors from the publisher.

Several typographical devices have been incorporated to serve as aids for students. Specifically,

- Technical terms are printed in boldface type when they first appear.
- Important concepts and theorems that do not involve equations are printed inside boxes.
- Asterisks (*) after problem numbers indicate that answers are provided at the back of the book.
- The symbol ‡ identifies the more challenging problems.

Tables at the back of the book include transform pairs, mathematical relations, and probability functions for convenient reference. An annotated bibliography is also provided at the back in the form of a supplementary reading list.

Communication system engineers use many abbreviations, so the index lists common abbreviations and their meanings. Thus, the index additionally serves as a guide to many abbreviations in communications.

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