Information, transmission, modulation and noise

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once remarked that the very best computer of the time had about the intelligence of a tape-worm."

As a nonprofessional in microprocessors, I found *The Micro Milleneum* delightful fireside reading, and can heartily recommend it.

Reprinted from *IEEE Communications Magazine*, May 1981.

Electronics–Circuits and Devices (2nd Edition)–Ralph J. Smith (New York: Wiley, 1980, 478 pp.). *Reviewed by J. F. Delansky, Department of Electrical Engineering, Pennsylvania State University, University Park, PA 16802.*

This is an updated version of a previously published book (1973). As is noted in the preface, the salient feature of this edition is the introduction of the microprocessor. According to the author, this text is planned for a one-term course at the sophomore level, is intended to be an introduction to the broad field of electronics, and can be covered in 50 fifty-minute lecturers. This seems to me to be very optimistic for a satisfying level of understanding.

Chapters 1, 2, and 3 provide a basic understanding of electrical quantities, circuit laws, and signal processing. Network theorems and applications are in terms of direct currents, but the properties of exponential and sinusoidal signals are described mathematically. Ideal amplifiers and diodes are introduced in Chapter 3 to provide interesting applications.

The next three chapters develop a quantitative understanding of electron behavior, semiconductor physics, and device behavior. Electron motion is described in Chapter 4, and the cathode-ray oscilloscope is introduced here for use in accompanying lab work. Chapter 5 focuses on the semiconductor diode; conduction, doping, and junction phenomena are used in deriving the external characteristics and a simple mathematical model. Chapter 6 focuses on transistors and thyristors and their integrated circuit forms; explanations of physical phenomena lead to quantitative descriptions of external characteristics.

The next three chapters provide an introduction to digital electronics. Chapter 7 uses simple models of diodes and transistors (based on the external characteristics derived in Chapters 5 and 6) to explain the operation of electronic switches, logic gates, and flip-flops. In Chapter 8 the emphasis is on binary representation, the analysis and synthesis of logic circuits, and their application in registers, counters, and memories. Chapter 9 provides an introduction to the microprocessor: basic concepts, computer architecture, programming, and the application of practical microprocessors.

Chapter 10 represents a sideways step to derive convenient methods for handling steady-state ac circuit problems. Practice is provided in series and parallel circuit analysis and the design of frequency selective circuits.

The next five chapters provide an introduction to linear electronics. Chapter 11 treats amplifiers in general and large-signal discrete-transistor amplifiers in particular; bias design and efficiency calculations for audio-frequency amplifiers are included. In Chapters 12 and 13, small-signal models of varying levels of sophistication are derived for field-effect and bipolar junction transistors, and applied to the analysis and design of small-signal amplifiers. Feedback concepts are described in Chapter 14, and the virtues of positive and negative feedback explored. Chapter 15 describes practical operational amplifiers and shows how inexpensive IC op amps can be used in the design of practical amplifiers, buffers, integrators, converters, regulators, oscillators, or analog computers.

The book features a two-color scheme. Most of the text lettering is in black, but a blue color is used in diagrams and graphs and for certain headings, and this helps to focus attention to the pertinent points. There is an adequate number of good examples worked throughout the text. The assignments at the end of each chapter are grouped into three categories. The Review Questions are primarily for the student's own use in testing his or her understanding of the concepts and terminology introduced in that chapter. The Exercises vary in difficulty, but, in general, they are straightforward applications of the new principles to specific situations. (Answers to Selected Exercises are included in the Appendix.) The Problems are more involved and may require extending a concept, or making simplifying assumptions, or putting ideas together in a design.

As always there is a (relatively small) number of typographical errors, and while most of these will cause no difficulty, a few may be troublesome to students.

I believe I would take a slightly different view of some of the topics covered, and an instructor can always do this if he desires. For example, concerning Thevenin (Norton) Theorem in Chapter 2, I would prefer to find $R_T(G_n)$ by applying a current (voltage) source excitation to the dead network, finding the voltage (current) response, then $R_T(G_n)$ is response/excitation. This makes equivalence of resistive 1-ports a special case of these theorems. It also will help later in discussing concepts of input and output impedances of amplifiers and feedback circuits.

Concerning the time needed to cover the material in this book, I think the author's suggested 50 fifty-minute lecturer is unrealistic unless it is done as a survey course for non-EE majors. For example, for an EE major, this would mean that Chapter 9, "Microprocessors," would have to be covered in 3.8 lectures (or less)! Also, for EE majors, more depth in a number of areas is needed, including, but not restricted to, addressing modes, instruction timing and operation, simple programs, additional I/O devices, flags, and bus concepts.

Nevertheless, the book is highly readable, well organized, and has good progression and building of ideas and concepts from simple to complex. I would recommend that it should be considered seriously by those involved with teaching an introductory course.

Reprinted from *IEEE Circuits and Systems Magazine*, March 1981.

Frequency-Response Methods in Control Systems–Alistair G. J. MacFarlane, Ed. (New York: IEEE Press, 1979, 516 pp.). *Reviewed by Elijah Polak, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA.*

This book was originally conceived by the Information Dissemination Committee of the IEEE Control Systems Society as a memorial volume to commemorate the life and work of Harry Nyquist. Rather than publishing an archival volume containing a complete collection of Nyquist's papers, many of which are not concerned with control systems, the IDC proposed a considerably more ambitious undertaking: the publication of a volume for wider readership, having both historical and current interest, which would display all the control theoretical developments that have emanated from Nyquist's seminal work. The editing of such a book could only be entrusted to a deep scholar, with access to excellent library facilities, whose good judgement would enable him to select from the enormous literature a representative sample of papers which would highlight both the major theoretical developments and the variety of applications of frequency domain techniques. It was most fortunate that the IDC succeeded in persuading Prof. A.G.J. MacFarlane to undertake this extremely demanding task.

Apart from the editor's preface and an obituary for Harry Nyquist by H. W. Bode, the book is organized into five parts and a very extensive 18-page bibliography. The parts are: I. The Development of Frequency Response Methods in Automatic Control, II. The Classical Frequency Response Techniques, III. Extensions to Nonlinear, Time–Varying and Stochastic Systems, IV. Multivariable Systems, and V. Multidimensional Systems. Within each part, the papers are arranged in chronological order. The results included in this volume range from those that are now mostly of historical interest to those that are so recent that they of as yet undetermined long-range value. The forty papers included in this book represent every major breakthrough in frequency domain related control system theory; in addition, many contain important extensions or clarifications. Consequently, this volume will serve as a most valuable reference for the researcher, teacher, and graduate student. Prof. MacFarlane must be congratulated on a successful completion of a very difficult mission.

Reprinted from *IEEE Circuits and System Magazine*, March 1981.

Information, Transmission, Modulation and Noise–Mischa Schwartz (New York: McGraw-Hill, 1980, 646 pp.). *Reviewed by Pramrod K. Varshney, Syracuse University, Syracuse, NY 13210.*

This is the third edition of the popular textbook on communication systems by Mischa Schwartz. The emphasis in this edition is on modern communication systems which are becoming increasingly digital. The book provides an up-to-date coverage of currently used communication system principles. An important feature of the book is that theoretical concepts are explained in terms of real-life examples drawn from various communication fields like telephony, space and satellite communications. This blend of theory and practice enhances the overall utility of the book which can be used in the classroom as well as by the practicing

engineers. The book is very well written and can be used in communication courses at the senior level or at the first year graduate level.

Chapter One provides an excellent introduction to the problems of information transmission. Information theoretic concepts are developed which establish fundamental bounds on the communication system capabilities. These results form the basis for the discussion throughout the book.

Chapter Two reviews the basic concepts of system and signal analysis. The reader is expected to have this background, and this chapter is intended to serve as a refresher. Inverse frequency-time relationship of signal transmission is emphasized and is developed through different examples.

Digital communication systems are discussed in Chapter Three. The topics covered include sampling, quantization, companding, PAM and PCM systems, delta modulation, time-division multiplexing, intersymbol interference, duobinary techniques and correlative coding. Several examples of practical systems are included. Overall design and optimization of baseband communication systems could have been discussed in more detail.

In Chapter Four, modulation techniques are described. Modulation schemes for both digital and analog communications are considered. Frequency-division multiplexing is also discussed. Once again a number of practical examples are presented to illustrate the underlying concepts.

In Chapter Five, the performance of communication systems in the presence of noise is considered. Performance in terms of the probability of error in digital communication systems and in terms of the signal-to-noise ratio in analog systems is derived. Characterization of the noise process is treated in the context of the overall performance issues of communication systems. The required probability theory and random variable background is available in the Appendix.

The sixth and the last chapter considers the problem of optimum information transmission and the design of optimum communication systems. The emphasis is on digital communications. Statistical decision theory is used for the optimum receiver design and optimum signal design problems. A discussion on coding techniques for error detection and correction is also included.

All of the chapters in this book have problems at the end which can be used for illustrations or homework. References are provided in the footnotes which is a little inconvenient as it requires a page-by-page search.

In summary, the up-to-date coverage, clarity of presentation, and proven track record of technical writing success of the author will make this new edition at least as popular as the earlier editions.

Reprinted from *IEEE Circuits and Systems Magazine*, March 1981.

BOOK ALERT

The following descriptions of recent books were prepared by the staff of the Engineering Societies Library, 345 East 47 Street, New York, NY 10017. These books are available in the Library for loan or reference use. The prospective buyer should contact the listed publishers or his local technical book store.

Database Security and Integrity (The Systems Programming Series)–E. B. Fernandez (Reading, MA: Addison Wesley, Jacob Way, 1981, 320 pp., bound, $17.95, ISBN 0-201-14417-0).

Chapter 1 defines the topics of the book, argues for their importance and introduces basic terminology. Chapter 2 reviews privacy concepts, privacy legislation, and current privacy issues. Chapter 3 summarizes the basic concepts and terminology of data-base systems. Chapter 4 is an overview of the entire computer security problem, showing where data-base security fits in. Chapter 5 discusses possible security policies, while Chapter 6 introduces model of data-base security. One of these models is used to structure some of the remaining chapters. The next chapter considers issues of authorization; that is, how users' rights to access the data-base are specified. Problems and techniques of integrity are described in Chapter 8. In Chapter 9 the topic of auditing and control is introduced and its relations to data-base security is discussed.

Chapter 10 introduces some basic design principles for systems that enforce security, discusses design choices, and describes the designs of a number of systems. Chapter 11 continues the treatment of security enforcement by describing operating-system and hardware mechanisms that support data-base security.

The special characteristics of security and integrity in distributed systems are considered in Chapter 12. The security of statistical data bases is treated in Chapter 13. Finally, Chapter 14 speculates on the future of data-base security.

Lasers in Modern Industry–John F. Ready (Dearborn, MI: Society of Manufacturing Engineers, 1979, 268 pp., bound, $25.00, ISBN 0-87263-052-8).

This book concentrates on applications in material processing in which the high-power beam from a laser modifies the properties of a workpiece. The workpiece is heated, melted, or vaporized and as a result operations such as hardening, welding, cutting, drilling, and trimming are routinely performed.

The various articles contain detailed information of how lasers have been used to tackle practical problems. Particularly useful should be data about the rate an operation can be performed: for example, how fast a seam weld is produced in a specific material. Such information allows the user to evaluate the potential use of lasers in a special application.

Chapters of interest include: no phase change heat treating; melting; material removal; and annealing;

Electromagnetic Fields and Relativistic Particles (International Series in Pure and Applied Physics)–Emil Jan Konopinski (New York: McGraw-Hill, 1981, 626 pp., bound, $25.95, ISBN 0-07-035264-X).

This book offers physical explanations of classical electromagnetism usually explained in purely mathematical terms. Its interpretation and explanation of the concept of electromagnetic vector potential makes applications of the concept (such as the transfer of momentum in betatrons) much easier to comprehend. The book offers explanations of potentially confusing phenomena often ignored elsewhere, such as the time fluctuations in monochromatic fields or the physical origin of the relativistic equations of motion for charge.

Different concepts and principles are carefully interrelated for maximum clarity. One relationship of classical physics to quantum mechanics, for example, is made clear through a detailed study of Zeeman effects on atoms.

The book discusses how simple Newtonian mechanics can describe the behavior of electrons and ions in fields and plasmas, and on the basis of this material, the results derived from relativity, featured later in the book, are much easier to understand. Modern discussions of relativistic processes are made understanble through the interrelation of "Mandelstam variables."

Stability of Nonlinear Systems, Volume 1. (Electronic & Electrical Engineering Research Studies) Control Theory and Applications Studies Theory, Volume 1)–Derek Atherton. (New York: Wiley, 1981, 231 pp., bound, $41.00, ISBN 0-471-27856-4).

The aim of this book is to give an overview of the techniques available for investigating the stability of an autonomous nonlinear feedback system. It is written so that it can be followed by a reader who has done a first course in automatic control theory and can be used as a text for undergraduate or postgraduate courses which include material on nonlinear systems.

Chapter 1 discusses nonlinear systems, the definitions of stability and the relationship of instability to the existence of limit cycles. Second order systems, both because of their historical importance and the general insight they provide for the understanding of more complex systems, are considered in Chapter 2.

In Chapter 3 the most useful available absolute stability criteria are presented and their applicability to various problems discussed. Chapter 4 presents the describing function (DF) method for investigating stability and the evaluation of limit cycles. The evaluation of asymmetrical limit cycles and the determination of the stability of a limit cycle are also discussed. Because the DF method is approximate it is important to have procedures for validating the accuracy of any solutions. This problem is discussed in Chapter 5 together with a discussion of the linearlization conjectures of Aizerman and Kalman.