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42UAWU - JAMIYA ALEXANDER

Discover the concepts, architectures, components, tools, and techniques needed to design millimeter-wave circuits for current and emerging wireless system applications. Focusing on applications in 5G, connectivity, radar, and more, leading experts in radio frequency integrated circuit (RFIC) design provide a comprehensive treatment of cutting-edge physical-layer technologies for radio frequency (RF) transceivers - specifically RF, analog, mixed-signal, and digital circuits and architectures. The full design chain is covered, from system design requirements through to building blocks, transceivers, and process tech-

nology. Gain insight into the key novelties of 5G through authoritative chapters on massive MIMO and phased arrays, and learn about the very latest technology developments, such as FinFET logic process technology for RF and millimeter-wave applications. This is an essential reading and an excellent reference for high-frequency circuit designers in both academia and industry.

Cellular telephones, satellite communications and radar systems are adding to the increasing demand for radio frequency circuit design principles. At the same time, several generations of digitally-oriented graduates are missing the essential RF

skills. This book contains a wealth of valuable design information difficult to find elsewhere. It's a complete 'tool kit' for successful RF circuit design. Written by experienced RF design engineers from Motorola's semiconductors product section. Book covers design examples of circuits (e.g. amplifiers; oscillators; switches; pulsed power; modular systems; wiring state-of-the-art devices; design techniques).

Over the past decade, tremendous development of wireless communications has changed human life and engineering. Considerable advancement has been made in design and architecture of related RF and microwave circuits. Introduction to Wire-

less Communication Circuits focuses on special circuits dedicated to the RF level of wireless communications. From oscillators to modulation and demodulation, and from mixers to RF and power amplifier circuits, all are presented in a sequential manner. A wealth of analytical relations is provided in the text alongside various worked out examples. Related problem sets are given at the end of each chapter. Basic concepts of RF Analog Circuit Design are developed in the book. Technical topics discussed include: - Wireless Communication System - RF Oscillators and Phase Locked Loops - Modulator and Demodulator Circuits - RF Mixers - Automatic Gain Control and Limiters - Microwave Circuits, Transmission Lines and S-Parameters - Matching Networks - Linear Amplifier Design and Power Amplifiers - Linearization Techniques This textbook is intended for advanced undergraduate and graduate students, as well as RF Engineers and professionals.

This new resource presents readers with all relevant information and comprehensive design methodology of wideband amplifiers. This book specifically focuses on distributed amplifiers and their main com-

ponents, and presents numerous RF and microwave applications including well-known historical and recent architectures, theoretical approaches, circuit simulation, and practical implementation techniques. A great resource for practicing designers and engineers, this book contains numerous well-known and novel practical circuits, architectures, and theoretical approaches with detailed description of their operational principles.

The Acclaimed RF Microelectronics Best-Seller, Expanded and Updated for the Newest Architectures, Circuits, and Devices Wireless communication has become almost as ubiquitous as electricity, but RF design continues to challenge engineers and researchers. In the 15 years since the first edition of this classic text, the demand for higher performance has led to an explosive growth of RF design techniques. In RF Microelectronics, Second Edition, Behzad Razavi systematically teaches the fundamentals as well as the state-of-the-art developments in the analysis and design of RF circuits and transceivers. Razavi has written the second edition to reflect today's RF microelectronics, covering key

topics in far greater detail. At nearly three times the length of the first edition, the second edition is an indispensable tome for both students and practicing engineers. With his lucid prose, Razavi now Offers a stronger tutorial focus along with hundreds of examples and problems Teaches design as well as analysis with the aid of step-by-step design procedures and a chapter dedicated to the design of a dual-band WiFi transceiver Describes new design paradigms and analysis techniques for circuits such as low-noise amplifiers, mixers, oscillators, and frequency dividers This edition's extensive coverage includes brand new chapters on mixers, passive devices, integer-N synthesizers, and fractional-N synthesizers. Razavi's teachings culminate in a new chapter that begins with Wi-Fi's radio specifications and, step by step, designs the transceiver at the transistor level. Coverage includes Core RF principles, including noise and nonlinearity, with ties to analog design, microwave theory, and communication systems An intuitive treatment of modulation theory and wireless standards from the standpoint of the RF IC designer Transceiver architectures such as heterodyne, sliding-IF, directcon-

version, image-reject, and low-IF topologies. Low-noise amplifiers, including cascode common-gate and commonsource topologies, noise-cancelling schemes, and reactance-cancelling configurations Passive and active mixers, including their gain and noise analysis and new mixer topologies Voltage-controlled oscillators, phase noise mechanisms, and various VCO topologies dealing with noise-power-tuning trade-offs All-new coverage of passive devices, such as integrated inductors, MOS varactors, and transformers A chapter on the analysis and design of phase-locked loops with emphasis on low phase noise and low spur levels Two chapters on integer-N and fractional-N synthesizers, including the design of frequency dividers Power amplifier principles and circuit topologies along with transmitter architectures, such as polar modulation and outphasing Equips students with essential industry-relevant knowledge through in-depth explanations, practical applications, examples, and exercises.

The products that drive the wireless communication industry, such as cell phones and pagers, employ circuits that operate at radio and microwave frequencies. Fol-

lowing on from a highly successful first edition, the second edition provides readers with a detailed introduction to RF and microwave circuits. Throughout, examples from real-world devices and engineering problems are used to great effect to illustrate circuit concepts. * Takes a top-down approach, describing circuits in the overall context of communication systems. * Presents expanded coverage of waveguides and FT mixers. * Discusses new areas such as oscillators design and digital communication. *An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, Second Edition highlights new, important developments in the field, including the latest on magnetic sensors, temperature sensors and microreaction chambers. The book outlines the industrial applications for smart sensors, covering direct interface circuits for sensors, capacitive sensors for displacement measurement in the sub-nanometer range, integrated inductive displacement sensors for harsh industrial environments, advanced silicon ra-

diation detectors in the vacuum ultraviolet (VUV) and extreme ultraviolet (EUV) spectral range, among other topics. New sections include discussions on magnetic and temperature sensors and the industrial applications of smart micro-electro-mechanical systems (MEMS). The book is an invaluable reference for academics, materials scientists and electrical engineers working in the microelectronics, sensors and micromechanics industry. In addition, engineers looking for industrial sensing, monitoring and automation solutions will find this a comprehensive source of information. Contains new chapters that address key applications, such as magnetic sensors, microreaction chambers and temperature sensors Provides an in-depth information on a wide array of industrial applications for smart sensors and smart MEMS Presents the only book to discuss both smart sensors and MEMS for industrial applications

This edition provides an important contemporary view of a wide range of analog/digital circuit blocks, the BSIM model, data converter architectures, and more. The authors develop design techniques for both

long- and short-channel CMOS technologies and then compare the two.

This informative, new resource presents the first comprehensive treatment of silicon-germanium heterojunction bipolar transistors (SiGe HBTs). It offers you a complete, from-the-ground-up understanding of SiGe HBT devices and technology, from a very broad perspective. The book covers motivation, history, materials, fabrication, device physics, operational principles, and circuit-level properties associated with this new cutting-edge semiconductor device technology. Including over 400 equations and more than 300 illustrations, this hands-on reference shows you in clear and concise language how to design, simulate, fabricate, and measure a SiGe HBT.

LEARN ABOUT MICROSYSTEMS PACKAGING FROM THE GROUND UP Written by Rao Tummala, the field's leading author, *Fundamentals of Microsystems Packaging* is the only book to cover the field from wafer to systems, including every major contributing technology. This rigorous and thorough introduction to electronic packaging technologies gives you a solid grounding in microelectronics, photonics, RF, packaging design, assembly, reliability, testing, and

manufacturing and its relevance to both semiconductors and systems. You'll find:

- *Full coverage of electrical, mechanical, chemical, and materials aspects of each technology
- *Easy-to-read schematics and block diagrams
- *Fundamental approaches to all system issues
- *Examples of all common configurations and technologies—wafer level packaging, single chip, multichip, RF, opto-electronic, microvia boards, thermal and others
- *Details on chip-to-board connections, sealing and encapsulation, and manufacturing processes
- *Basics of electrical and reliability testing

Fundamentals of Microelectronics, 2nd Edition is designed to build a strong foundation in both design and analysis of electronic circuits this text offers conceptual understanding and mastery of the material by using modern examples to motivate and prepare readers for advanced courses and their careers. The book's unique problem-solving framework enables readers to deconstruct complex problems into components that they are familiar with which builds the confidence and intuitive skills needed for success.

By helping students develop an intuitive

understanding of the subject, *Microelectronics* teaches them to think like engineers. The second edition of Razavi's *Microelectronics* retains its hallmark emphasis on analysis by inspection and building students' design intuition, and it incorporates a host of new pedagogical features that make it easier to teach and learn from, including: application sidebars, self-check problems with answers, simulation problems with SPICE and MULTISIM, and an expanded problem set that is organized by degree of difficulty and more clearly associated with specific chapter sections.

This junior level electronics text provides a foundation for analyzing and designing analog and digital electronics throughout the book. Extensive pedagogical features including numerous design examples, problem solving technique sections, Test Your Understanding questions, and chapter checkpoints lend to this classic text. The author, Don Neamen, has many years experience as an Engineering Educator. His experience shines through each chapter of the book, rich with realistic examples and practical rules of thumb. The Third Edition continues to offer the same hallmark features that made the previous

editions such a success. Extensive Pedagogy: A short introduction at the beginning of each chapter links the new chapter to the material presented in previous chapters. The objectives of the chapter are then presented in the Preview section and then are listed in bullet form for easy reference. Test Your Understanding Exercise Problems with provided answers have all been updated. Design Applications are included at the end of chapters. A specific electronic design related to that chapter is presented. The various stages in the design of an electronic thermometer are explained throughout the text. Specific Design Problems and Examples are highlighted throughout as well.

This publication presents cleaning and etching solutions, their applications, and results on inorganic materials. It is a comprehensive collection of etching and cleaning solutions in a single source. Chemical formulas are presented in one of three standard formats - general, electrolytic or ionized gas formats - to insure inclusion of all necessary operational data as shown in references that accompany each numbered formula. The book describes other applications of specific solutions, including

their use on other metals or metallic compounds. Physical properties, association of natural and man-made minerals, and materials are shown in relationship to crystal structure, special processing techniques and solid state devices and assemblies fabricated. This publication also presents a number of organic materials which are widely used in handling and general processing...waxes, plastics, and lacquers for example. It is useful to individuals involved in study, development, and processing of metals and metallic compounds. It is invaluable for readers from the college level to industrial R & D and full-scale device fabrication, testing and sales. Scientific disciplines, work areas and individuals with great interest include: chemistry, physics, metallurgy, geology, solid state, ceramic and glass, research libraries, individuals dealing with chemical processing of inorganic materials, societies and schools.

A self-contained guide to microwave electronics, covering passive and active components, linear, low-noise and power amplifiers, microwave measurements, and CAD techniques. It is the ideal text for graduate and senior undergraduate students taking courses in microwave and radio-fre-

quency electronics, as well as professional microwave engineers.

CMOS, BiCMOS, GaAs, SiGe, SiC, SiC-MOS, SiC-MOS.

This Special Issue focuses on the state-of-the-art results from the definition and design of filters for low- and high-frequency applications and systems. Different technologies and solutions are commonly adopted for filter definition, from electrical to electromechanical and mechanical solutions, from passive to active devices, and from hybrid to integrated designs. Aspects related to both theoretical and experimental research in filter design, CAD modeling and novel technologies and applications, as well as filter fabrication, characterization and testing, are covered. The proposed research articles deal with different topics as follows: Modeling, design and simulation of filters; Processes and fabrication technologies for filters; Automated characterization and test of filters; Voltage and current mode filters; Integrated and discrete filters; Passive and active filters; Variable filters, characterization and tunability. This book presents the latest develop-

ments in packaging for high-frequency electronics. It is a companion volume to “RF and Microwave Microelectronics Packaging” (2010) and covers the latest developments in thermal management, electrical/RF/thermal-mechanical designs and simulations, packaging and processing methods, and other RF and microwave packaging topics. Chapters provide detailed coverage of phased arrays, T/R modules, 3D transitions, high thermal conductivity materials, carbon nanotubes and graphene advanced materials, and chip size packaging for RF MEMS. It appeals to practicing engineers in the electronic packaging and high-frequency electronics domain, and to academic researchers interested in understanding the leading issues in the commercial sector. It is also a good reference and self-studying guide for students seeking future employment in consumer electronics. David Pozar, author of *Microwave Engineering, Second Edition*, has written a new text that introduces students to the field of wireless communications. This text offers a quantitative and, design-oriented presentation of the analog RF aspects of modern wireless telecommunications and data transmission systems from the antenna to

the baseband level. Other topics include noise, intermodulation, dynamic range, system aspects of antennas and filter design. This unique text takes an integrated approach to topics usually offered in a variety of separate courses on topics such as antennas and propagation, microwave systems and circuits, and communication systems. This approach allows for a complete presentation of wireless telecommunications systems designs. The author's goal with this text is for the student to be able to analyze a complete radio system from the transmitter through the receiver front-end, and quantitatively evaluate factors. Suitable for a one-semester course, at the senior or first year graduate level. Note certain sections have been denoted as advanced topics, suitable for graduate level courses.

The recent shift in focus from defense and government work to commercial wireless efforts has caused the job of the typical microwave engineer to change dramatically. The modern microwave and RF engineer is expected to know customer expectations, market trends, manufacturing technologies, and factory models to a degree that

is unprecedented in the

The book provides a comprehensive overview of electromigration and its effects on the reliability of electronic circuits. It introduces the physical process of electromigration, which gives the reader the requisite understanding and knowledge for adopting appropriate counter measures. A comprehensive set of options is presented for modifying the present IC design methodology to prevent electromigration. Finally, the authors show how specific effects can be exploited in present and future technologies to reduce electromigration's negative impact on circuit reliability.

Using a modern, pedagogical approach, this textbook gives students and engineers a comprehensive and rigorous knowledge of CMOS phase-locked loop (PLL) design for a wide range of applications. It features intuitive presentation of theoretical concepts, built up gradually from their simplest form to more practical systems; broad coverage of key topics, including oscillators, phase noise, analog PLLs, digital PLLs, RF synthesizers, delay-locked loops, clock and data recovery circuits, and frequency dividers; tutorial chapters on high-

-performance oscillator design, covering fundamentals to advanced topologies; and extensive use of circuit simulations to teach design mentality, highlight design flaws, and connect theory with practice. Including over 200 thought-provoking examples highlighting best practices and common pitfalls, 250 end-of-chapter homework problems to test and enhance the readers' understanding, and solutions and lecture slides for instructors, this is the perfect text for senior undergraduate and graduate-level students and professional engineers who want an in-depth understanding of PLL design.

Building on the success of the previous three editions, Foundations for Microstrip Circuit Design offers extensive new, updated and revised material based upon the latest research. Strongly design-oriented, this fourth edition provides the reader with a fundamental understanding of this fast expanding field making it a definitive source for professional engineers and researchers and an indispensable reference for senior students in electronic engineering. Topics new to this edition: microwave substrates, multilayer transmission line structures, modern EM tools and tech-

niques, microstrip and planar transmission line design, transmission line theory, substrates for planar transmission lines, Vias, wirebonds, 3D integrated interposer structures, computer-aided design, microstrip and power-dependent effects, circuit models, microwave network analysis, microstrip passive elements, and slotline design fundamentals.

An interdisciplinary guide to enabling technologies for 3D ICs and 5G mobility, covering packaging, design to product life and reliability assessments Features an interdisciplinary approach to the enabling technologies and hardware for 3D ICs and 5G mobility Presents statistical treatments and examples with tools that are easily accessible, such as Microsoft's Excel and Minitab Fundamental design topics such as electromagnetic design for logic and RF/passives centric circuits are explained in detail Provides chapter-wise review questions and powerpoint slides as teaching tools

Highlighting the challenges RF and microwave circuit designers face in their day-to-day tasks, RF and Microwave Circuits, Measurements, and Modeling explores RF

and microwave circuit designs in terms of performance and critical design specifications. The book discusses transmitters and receivers first in terms of functional circuit block and then examines each block individually. Separate articles consider fundamental amplifier issues, low noise amplifiers, power amplifiers for handset applications and high power, power amplifiers. Additional chapters cover other circuit functions including oscillators, mixers, modulators, phase locked loops, filters and multiplexers. New chapters discuss high-power PAs, bit error rate testing, and non-linear modeling of heterojunction bipolar transistors, while other chapters feature new and updated material that reflects recent progress in such areas as high-volume testing, transmitters and receivers, and CAD tools. The unique behavior and requirements associated with RF and microwave systems establishes a need for unique and complex models and simulation tools. The required toolset for a microwave circuit designer includes unique device models, both 2D and 3D electromagnetic simulators, as well as frequency domain based small signal and large signal circuit and system simulators. This

unique suite of tools requires a design procedure that is also distinctive. This book examines not only the distinct design tools of the microwave circuit designer, but also the design procedures that must be followed to use them effectively.

VLSI for Wireless Communication, Second Edition, an advanced level text book, takes a system approach starting with an overview of the most up to date wireless systems and the transceiver architecture available today. Wireless standards are first introduced (updated to include the most recent 3G/4G standards in the second edition), and translates from a wireless standard to the implementation of a transceiver. This system approach is particularly important as the level of integration in VLSI increases and coupling between system and component design becomes more intimate. VLSI for Wireless Communication, Second Edition, illustrates designs with full design examples. Each chapter includes at least one complete design example that helps explain the architecture/circuits presented in this text. This book has close to 10 homework problems at the end of each chapter. A complete solutions manual is available on-line. VLSI for Wireless

Communication, Second Edition, is designed as a primary text book for upper-undergraduate level students and graduate level students concentrating on electrical engineering and computer science. Professional engineers and researchers working in wireless communications, circuit design and development will find this book valuable as well.

This book describes the design and implementation of an electronic subsystem called the frequency synthesizer, which is a very important building block for any wireless transceiver. The discussion includes several new techniques for the design of such a subsystem which include the usage modes of the wireless device, including its support for several leading-edge wireless standards. This new perspective for designing such a demanding subsystem is based on the fact that optimizing the performance of a complete system is not always achieved by optimizing the performance of its building blocks separately. This book provides “hands-on” examples of this sort of co-design of optimized subsystems, which can make the vision of an always-best-connected scenario a reality.

A broad and comprehensive survey of the fundamentals for electrochemical methods now in widespread use. This book is meant as a textbook, and can also be used for self-study as well as for courses at the senior undergraduate and beginning graduate levels. Knowledge of physical chemistry is assumed, but the discussions start at an elementary level and develop upward. This revision comes twenty years after publication of the first edition, and provides valuable new and updated coverage. Pozar's new edition of Microwave Engineering includes more material on active circuits, noise, nonlinear effects, and wireless systems. Chapters on noise and nonlinear distortion, and active devices have been added along with the coverage of noise and more material on intermodulation distortion and related nonlinear effects. On active devices, there's more updated material on bipolar junction and field effect transistors. New and updated material on wireless communications systems, including link budget, link margin, digital modulation methods, and bit error rates is also part of the new edition. Other new material includes a section on transients on transmission lines, the theory of power waves, a

discussion of higher order modes and frequency effects for microstrip line, and a discussion of how to determine unloaded. A comprehensive guide to MEMS materials, technologies and manufacturing, examining the state of the art with a particular emphasis on current and future applications. Key topics covered include: Silicon as MEMS material Material properties and measurement techniques Analytical methods used in materials characterization Modeling in MEMS Measuring MEMS Micromachining technologies in MEMS Encapsulation of MEMS components Emerging process technologies, including ALD and porous silicon Written by 73 world class MEMS contributors from around the globe, this volume covers materials selection as well as the most important process steps in bulk micromachining, fulfilling the needs of device design engineers and process or development engineers working in manufacturing processes. It also provides a comprehensive reference for the industrial R&D and academic communities. Veikko Lindroos is Professor of Physical Metallurgy and Materials Science at Helsinki University of Technology, Finland. Markku Tilli is Senior Vice President of Research at Okmet-

ic, Vantaa, Finland. Ari Lehto is Professor of Silicon Technology at Helsinki University of Technology, Finland. Teruaki Motooka is Professor at the Department of Materials Science and Engineering, Kyushu University, Japan. Provides vital packaging technologies and process knowledge for silicon direct bonding, anodic bonding, glass frit bonding, and related techniques Shows how to protect devices from the environment and decrease package size for dramatic reduction of packaging costs Discusses properties, preparation, and growth of silicon crystals and wafers Explains the many properties (mechanical, electrostatic, optical, etc), manufacturing, processing, measuring (incl. focused beam techniques), and multiscale modeling methods of MEMS structures

This modern, pedagogic textbook from leading author Behzad Razavi provides a comprehensive and rigorous introduction to CMOS PLL design, featuring intuitive presentation of theoretical concepts, extensive circuit simulations, over 200 worked examples, and 250 end-of-chapter problems. The perfect text for senior undergraduate and graduate students.

Essential reading for experts in the field of RF circuit design and engineers needing a good reference. This book provides complete design procedures for multiple-pole Butterworth, Chebyshev, and Bessel filters. It also covers capacitors, inductors, and other components with their behavior at RF frequencies discussed in detail. Provides complete design procedures for multiple-pole Butterworth, Chebyshev, and Bessel filters Covers capacitors, inductors, and other components with their behavior at RF frequencies discussed in detail

A majority of people now have a digital mobile device whether it be a cell phone, laptop, or blackberry. Now that we have the mobility we want it to be more versatile and dependable; RF power amplifiers accomplish just that. These amplifiers take a small input and make it stronger and larger creating a wider area of use with a more robust signal. Switching mode RF amplifiers have been theoretically possible for decades, but were largely impractical because they distort analog signals until they are unrecognizable. However, distortion is not an issue with digital signals—like those used by WLANs and digital cell phones—and switching mode RF amplifiers

have become a hot area of RF/wireless design. This book explores both the theory behind switching mode RF amplifiers and design techniques for them. *Provides essential design and implementation techniques for use in cma2000, WiMAX, and other digital mobile standards *Both authors have written several articles on the topic and are well known in the industry *Includes specific design equations to greatly simplify the design of switchmode amplifiers

The ultimate practical resource for today's RF system design professionals Radio frequency components and circuits form the backbone of today's mobile and satellite communications networks. Consequently, both practicing and aspiring industry professionals need to be able to solve ever more complex problems of RF design. Blending theoretical rigor with a wealth of practical expertise, Practical RF System Design addresses a variety of complex, real-world problems that system engineers are likely to encounter in today's burgeoning communications industry with solutions that are not easily available in the existing literature. The author, an expert in the field of RF module and system design, pro-

vides powerful techniques for analyzing real RF systems, with emphasis on some that are currently not well understood. Combining theoretical results and models with examples, he challenges readers to address such practical issues as: * How standing wave ratio affects system gain * How noise on a local oscillator will affect receiver noise figure and desensitization * How to determine the dynamic range of a cascade from module specifications * How phase noise affects system performance and where it comes from * How intermodulation products (IMs) predictably change with signal amplitude, and why they sometimes change differently An essential resource for today's RF system engineers, the text covers important topics in the areas of system noise and nonlinearity, frequency conversion, and phase noise. Along with a wealth of practical examples using MATLAB(r) and Excel, spreadsheets are available for download from an FTP Web site to help readers apply the methods outlined in this important resource.

The striking feature of this book is its coverage of the upper GHz domain. However, the latest technologies, applications and broad range of circuits are discussed. De-

sign examples are provided including cookbook-like optimization strategies. This state-of-the-art book is valuable for researchers as well as for engineers in industry. Furthermore, the book serves as fruitful basis for lectures in the area of IC design.

"Microelectronic Circuit Design" is known for being a technically excellent text. The new edition has been revised to make the material more motivating and accessible to students while retaining a student-friendly approach. Jaeger has added more pedagogy and an emphasis on design through the use of design examples and design notes. Some pedagogical elements include chapter opening vignettes, chapter objectives, "Electronics in Action" boxes, a problem solving methodology, and "design note" boxes. The number of examples, including new design examples, has been increased, giving students more opportunity to see problems worked out. Additionally, some of the less fundamental mathematical material has been moved to the ARIS website. In addition this edition comes with a Homework Management System called ARIS, which includes 450 static

problems.

The modern electronic testing has a forty year history. Test professionals hold some fairly large conferences and numerous workshops, have a journal, and there are over one hundred books on testing. Still, a full course on testing is offered only at a few universities, mostly by professors who have a research interest in this area. Apparently, most professors would not have taken a course on electronic testing when they were students. Other than the computer engineering curriculum being too

crowded, the major reason cited for the absence of a course on electronic testing is the lack of a suitable textbook. For VLSI the foundation was provided by semiconductor device technology, circuit design, and electronic testing. In a computer engineering curriculum, therefore, it is necessary that foundations should be taught before applications. The field of VLSI has expanded to systems-on-a-chip, which include digital, memory, and mixed-signal-subsystems. To our knowledge this is the first textbook to cover all three types of electronic circuits. We have written this

textbook for an undergraduate “foundations” course on electronic testing. Obviously, it is too voluminous for a one-semester course and a teacher will have to select from the topics. We did not restrict such freedom because the selection may depend upon the individual expertise and interests. Besides, there is merit in having a larger book that will retain its usefulness for the owner even after the completion of the course. With equal tenacity, we address the needs of three other groups of readers.