Device Electronics For Integrated Circuits Free

Since overall circuit performance has depended primarily on transistor properties, previous efforts to enhance circuit and system speed were focused on transistors as well. During the last decade, however, the parasitic resistance, capacitance, and inductance associated with interconnections began to influence circuit performance and will be the primary factors in the evolution of nanoscale ULSI technology. Because metallic conductivity and resistance to electromigration of bulk copper (Cu) are better than aluminum, use of copper and low-k materials is now prevalent in the international microelectronics industry. As the feature size of the Cu-lines forming interconnects is scaled, resistivity of the lines increases. At the same time electromigration and stress-induced voids due to increased current density become significant reliability issues. Although copper/low-k technology has become fairly mature, there is no single book available on the promise and challenges of these next-generation technologies. In this book, a leader in the field describes advanced laser systems with lower radiation wavelengths, photolithography materials, and mathematical modeling approaches to address the challenges of Cu-interconnect technology.

In der Praxis, aber auch in den verschiedenen Forschungseinrichtungen muss man sich oft rasch über bestimmte Gebiete der Schaltungstechnik informieren. In dieser Situation reichen einerseits die sehr knappen

Darstellungen eines Lexikons in der Regel nicht aus, andererseits muss man aber aus Zeitgründen auf umfangreiche Beschreibungen der zahlreichen Lehrbücher verzichten. Für diese Problematik findet dieses Buch eine anspruchsvolle Lösung. Es behandelt in zehn Beiträgen die wichtigsten Gebiete der analogen und digitalen integrierten Schaltungstechnik. Neben der übersichtlichen und kompakten Darstellung des Aufbaus, der Funktionsweise und der Dimensionierung komplexer elektronischer Schaltungen wird auch auf die Aspekte der Modellierung und Simulation eingegangen. Jedes Kapitel enthält aktuelle Hinweise über weiterführende Literatur bzw. ggf. Internet-Adressen.

The Fifth Edition of this academically rigorous text provides a comprehensive treatment of analog integrated circuit analysis and design starting from the basics and through current industrial practices. The authors combine bipolar, CMOS and BiCMOS analog integrated-circuit design into a unified treatment that stresses their commonalities and highlights their differences. The comprehensive coverage of the material will provide the student with valuable insights into the relative strengths and weaknesses of these important technologies.

Focusing specifically on silicon devices, the Third Edition of Device Electronics for Integrated Circuits takes students in integrated-circuits courses from fundamental physics to detailed device operation. Because the book focuses primarily on silicon devices, each topic can include more depth, and extensive worked examples and practice problems ensure that students understand the details.

Millimeter-Wave Integrated Circuits delivers a detailed overview of MMIC design, specifically focusing on designs for the millimeter-wave (mm-wave) frequency range. The scope of the book is broad, spanning detailed discussions of high-frequency materials and technologies, high-frequency devices, and the design of high-frequency circuits. The design material is supplemented as appropriate by theoretical analyses. The broad scope of the book gives the reader a good theoretical and practical understanding of mm-wave circuit design. It is best-suited for both undergraduate students who are reading or studying high frequency circuit design and postgraduate students who are specializing in the mm-wave field.

Designed Primarily For Courses In Operational Amplifier And Linear Integrated Circuits For Electrical, Electronic, Instrumentation And Computer Engineering And Applied Science Students. Includes Detailed Coverage Of Fabrication Technology Of Integrated Circuits. Basic Principles Of Operational Amplifier, Internal Construction And Applications Have Been Discussed. Important Linear Ics Such As 555 Timer, 565 Phase-Locked Loop, Linear Voltage Regulator Ics 78/79 Xx And 723 Series D-A And A-D Converters Have Been Discussed In Individual Chapters. Each Topic Is Covered In Depth. Large Number Of Solved Problems, Review Questions And Experiments Are Given With Each Chapter For Better Understanding Of Text.Salient Features Of Second Edition * Additional Information Provided Wherever Necessary To Improve The Understanding Of Linear Ics. * Chapter 2 Has Been Thoroughly Revised. *

Dc & Ac Analysis Of Differential Amplifier Has Been Discussed In Detail. * The Section On Current Mirrors Has Been Thoroughly Updated. * More Solved Examples, Pspice Programs And Answers To Selected Problems Have Been Added.

This book, now in its Second Edition, provides a basis for understanding the characteristics, working principle, operation and limitations of semi-conductor devices. In this new edition, many sections are re-written to present the concepts related to device physics in more clearer and easy to understand manner. The primary objective of this textbook is to provide all the relevant topics on the semiconductor materials and semiconductor devices in a single volume. It includes enough mathematical expressions to provide a good foundation for the basic understanding of the semiconductor devices. It covers not only the state-of-the-art devices but also future approaches that go beyond the current technology. Designed primarily as a text for the postgraduate students of physics and electronics, the book would also be useful for the undergraduate students of electronics and electrical engineering, and electronics and communication engineering. Highlights of the Book : Includes topics on the latest technologies Covers important points in each chapter Provides a number of solved and unsolved problems along with explanation type questions Emphasizes on the mathematical derivation

Reference Data for Engineers is the most respected, reliable, and indispensable reference tool for technical professionals around the globe. Written by professionals for professionals, this book is a complete reference for

engineers, covering a broad range of topics. It is the combined effort of 96 engineers, scientists, educators, and other recognized specialists in the fields of electronics, radio, computer, and communications technology. By providing an abundance of information on essential, need-to-know topics without heavy emphasis on complicated mathematics, Reference Data for Engineers is an absolute "must-have" for every engineer who requires comprehensive electrical, electronics, and communications data at his or her fingertips. Featured in the Ninth Edition is updated coverage on intellectual property and patents, probability and design, antennas, power electronics, rectifiers, power supplies, and properties of materials. Useful information on units, constants and conversion factors, active filter design, antennas, integrated circuits, surface acoustic wave design, and digital signal processing is also included. The Ninth Edition also offers new knowledge in the fields of satellite technology, space communication, microwave science, telecommunication, global positioning systems, frequency data, and radar. * Widely acclaimed as the most practical reference ever published for a wide range of electronics and computer professionals, from technicians through post-graduate engineers. * Provides a great way to learn or review the basics of various technologies, with a minimum of tables, equations, and other heavy math.

Featuring hundreds of illustrations and references, this volume in the third edition of the Circuits and Filters Handbook, provides the latest information on analog and VLSI circuits, omitting extensive theory and proofs in favor of

numerous examples throughout each chapter. The first part of the text focuses on analog integrated circuits, presenting up-to-date knowledge on monolithic device models, analog circuit cells, high performance analog circuits, RF communication circuits, and PLL circuits. In the second half of the book, well-known contributors offer the latest findings on VLSI circuits, including digital systems, data converters, and systolic arrays.

A reprint of the classic text, this book popularized compact modeling of electronic and semiconductor devices and components for college and graduate-school classrooms, and manufacturing engineering, over a decade ago. The first comprehensive book on MOS transistor compact modeling, it was the most cited among similar books in the area and remains the most frequently cited today. The coverage is device-physics based and continues to be relevant to the latest advances in MOS transistor modeling. This is also the only book that discusses in detail how to measure device model parameters required for circuit simulations. The book deals with the MOS Field Effect Transistor (MOSFET) models that are derived from basic semiconductor theory. Various models are developed, ranging from simple to more sophisticated models that take into account new physical effects observed in submicron transistors used in today's (1993) MOS VLSI technology. The assumptions used to arrive at the models are emphasized so that the accuracy of the models in describing the device characteristics are clearly understood. Due to the importance of designing reliable circuits, device reliability models are also covered. Understanding these models is essential when designing circuits for state-of-the-art MOS ICs.

This textbook is ideal for senior undergraduate and graduate courses in RF CMOS circuits, RF circuit design, and high-frequency analog circuit design. It is aimed at electronics

engineering students, as well as IC design engineers in the field, who wish to gain a deeper understanding of circuit fundamentals and go beyond the widely-used automated design procedures. A design-centric approach is adopted in order to bridge the gap between fundamental analog electronic circuits textbooks and more advanced RF IC design texts. The structure and operation of the building blocks of high-frequency ICs are introduced in a systematic manner, with an emphasis on transistor-level operation, the influence of device characteristics and parasitic effects, and input-output behavior in the time and frequency domains. This second edition has been revised extensively to expand and clarify some of the key topics and to provide a wide range of design examples and problems. New material has been added for basic coverage of core topics, such as wide-band LNAs, noise feedback concept and noise cancellation, inductive-compensated band widening techniques for flat-gain or flat-delay characteristics, and basic communication system concepts that exploit the convergence and co-existence of Analog and Digital building blocks in RF systems. A new chapter (Chapter 5) has been added on Noise and Linearity, addressing key topics in a comprehensive manner. All of the other chapters have also been revised and largely re-written, with the addition of numerous solved design examples and exercise problems. Designed for senior undergraduate and graduate courses in RF CMOS circuits, RF circuit design, and high-frequency analog circuit design; Uses simple circuit models to enable a robust understanding of high-frequency design fundamentals; Employs solved design examples to familiarize the reader with the design flow, starting with knowledge-based and model-based hand-design and progressing to SPICE simulations; Introduces fine-tuning procedures in circuit design with an emphasis on key trade-offs; Demonstrates key

criteria and parameters that are used to describe system-level performance. .

Modern Semiconductor Devices for Integrated Circuits, First Edition introduces readers to the world of modern semiconductor devices with an emphasis on integrated circuit applications. KEY TOPICS: Electrons and Holes in Semiconductors; Motion and Recombination of Electrons and Holes; Device Fabrication Technology; PN and Metal–Semiconductor Junctions; MOS Capacitor; MOS Transistor; MOSFETs in ICs—Scaling, Leakage, and Other Topics; Bipolar Transistor. MARKET: Written by an experienced teacher, researcher, and expert in industry practices, this succinct and forward-looking text is appropriate for anyone interested in semiconductor devices for integrated curcuits, and serves as a suitable reference text for practicing engineers.

Silicon-on-Insulator Technology: Materials to VLSI, Third Edition, retraces the evolution of SOI materials, devices and circuits over a period of roughly twenty years. Twenty years of progress, research and development during which SOI material fabrication techniques have been born and abandoned, devices have been invented and forgotten, but, most importantly, twenty years during which SOI Technology has little by little proven it could outperform bulk silicon in every possible way. The turn of the century turned out to be a milestone for the semiconductor industry, as high-quality SOI wafers suddenly became available in large quantities. From then on, it took only a few years to witness the use of SOI technology in a wealth of applications ranging from audio amplifiers and wristwatches to 64-bit microprocessors. This book presents a complete and state-of-the-art review of SOI materials, devices and circuits. SOI fabrication and characterization techniques, SOI CMOS processing, and the physics of the SOI MOSFET receive an in-depth analysis.

Standard-setting, groundbreaking, authoritative, comprehensive—these often overused words perfectly describe The Circuits and Filters Handbook, Third Edition. This standard-setting resource has documented the momentous changes that have occurred in the field of electrical engineering, providing the most comprehensive coverage available. More than 150 contributing experts offer in-depth insights and enlightened perspectives into standard practices and effective techniques that will make this set the first—and most likely the only—tool you select to help you with problem solving. In its third edition, this groundbreaking bestseller surveys accomplishments in the field, providing researchers and designers with the comprehensive detail they need to optimize research and design. All five volumes include valuable information on the emerging fields of circuits and filters, both analog and digital. Coverage includes key mathematical formulas, concepts, definitions, and derivatives that must be mastered to perform cutting-edge research and design. The handbook avoids extensively detailed theory and instead concentrates on professional applications, with numerous examples provided throughout. The set includes more than 2500 illustrations and hundreds of references. Available as a comprehensive five-volume set, each of the subject-specific volumes can also be purchased separately. To surmount the continuous scaling challenges of MOSFET devices, FinFETs have emerged as the real alternative for use as the next generation device for IC fabrication technology. The objective of this book is to provide the basic theory and operating principles of FinFET devices and technology, an overview of FinFET device architecture and manufacturing processes, and detailed formulation of FinFET electrostatic and dynamic device characteristics for IC design and manufacturing. Thus, this book caters to practicing engineers transitioning to FinFET technology and prepares

the next generation of device engineers and academic experts on mainstream device technology at the nanometer-nodes.

Analog Integrated Circuits for Communication: Principles, Simulation and Design, Second Edition covers the analysis and design of nonlinear analog integrated circuits that form the basis of present-day communication systems. Both bipolar and MOS transistor circuits are analyzed and several numerical examples are used to illustrate the analysis and design techniques developed in this book. Especially unique to this work is the tight coupling between the first-order circuit analysis and circuit simulation results. Extensive use has been made of the public domain circuit simulator Spice, to verify the results of first-order analyses, and for detailed simulations with complex device models. Highlights of the new edition include: A new introductory chapter that provides a brief review of communication systems, transistor models, and distortion generation and simulation. Addition of new material on MOSFET mixers, compression and intercept points, matching networks. Revisions of text and explanations where necessary to reflect the new organization of the book Spice input files for all the circuit examples that are available to the reader from a website. Problem sets at the end of each chapter to reinforce and apply the subject matter. An instructors solutions manual is available on the book's webpage at springer.com. Analog Integrated Circuits for Communication: Principles, Simulation and Design, Second Edition is for readers who have completed an introductory course in analog circuits and are familiar with basic analysis techniques as well as with the operating principles of semiconductor devices. This book also serves as a useful reference for practicing engineers.

STUDENT COMPANION SITE Every new copy of Stuart

Wentworth's Applied Electromagnetics comes with a registration code which allows access to the Student's Book Companion Site. On the BCS the student will find: * Detailed Solutions to Odd-Numbered Problems in the text * Detailed Solutions to all Drill Problems from the text * MATLAB code for all the MATLAB examples in the text * Additional MATLAB demonstrations with code. This includes a Transmission Lines simulator created by the author. * Weblinks to a vast array of resources for the engineering student. Go to www.wiley.com/college/wentworth to link to Applied Electromagnetics and the Student Companion Site. ABOUT THE PHOTO Passive RFID systems, consisting of readers and tags, are expected to replace bar codes as the primary means of identification, inventory and billing of everyday items. The tags typically consist of an RFID chip placed on a flexible film containing a planar antenna. The antenna captures radiation from the reader's signal to power the tag electronics, which then responds to the reader's query. The PENI Tag (Product Emitting Numbering Identification Tag) shown, developed by the University of Pittsburgh in a team led by Professor Marlin H. Mickle, integrates the antenna with the rest of the tag electronics. RFID systems involve many electomagnetics concepts, including antennas, radiation, transmission lines, and microwave circuit components. (Photo courtesy of Marlin H. Mickle.) BiCMOS Technology and Applications, Second Edition provides a synthesis of available knowledge about the combination of bipolar and MOS transistors in a common integrated circuit - BiCMOS. In this new edition all

chapters have been updated and completely new chapters on emerging topics have been added. In addition, BiCMOS Technology and Applications, Second Edition provides the reader with a knowledge of either CMOS or Bipolar technology/design a reference with which they can make educated decisions regarding the viability of BiCMOS in their own application. BiCMOS Technology and Applications, Second Edition is vital reading for practicing integrated circuit engineers as well as technical managers trying to evaluate business issues related to BiCMOS. As a textbook, this book is also appropriate at the graduate level for a special topics course in BiCMOS. A general knowledge in device physics, processing and circuit design is assumed. Given the division of the book, it lends itself well to a two-part course; one on technology and one on design. This will provide advanced students with a good understanding of tradeoffs between bipolar and MOS devices and circuits. Polycrystalline Silicon for Integrated Circuits and Displays, Second Edition presents much of the available knowledge about polysilicon. It represents an effort to interrelate the deposition, properties, and applications of polysilicon. By properly understanding the properties of polycrystalline silicon and their relation to the deposition conditions, polysilicon can be designed to ensure optimum device and integrated-circuit performance. Polycrystalline silicon has played an important role in integrated-circuit technology for two decades. It was first used in self-aligned, silicon-gate, MOS ICs to reduce capacitance and improve circuit speed. In addition to this dominant use, polysilicon is now also included in virtually

all modern bipolar ICs, where it improves the basic physics of device operation. The compatibility of polycrystalline silicon with subsequent high-temperature processing allows its efficient integration into advanced IC processes. This compatibility also permits polysilicon to be used early in the fabrication process for trench isolation and dynamic random-access-memory (DRAM) storage capacitors. In addition to its integrated-circuit applications, polysilicon is becoming vital as the active layer in the channel of thin-film transistors in place of amorphous silicon. When polysilicon thin-film transistors are used in advanced active-matrix displays, the peripheral circuitry can be integrated into the same substrate as the pixel transistors. Recently, polysilicon has been used in the emerging field of microelectromechanical systems (MEMS), especially for microsensors and microactuators. In these devices, the mechanical properties, especially the stress in the polysilicon film, are critical to successful device fabrication. Polycrystalline Silicon for Integrated Circuits and Displays, Second Edition is an invaluable reference for professionals and technicians working with polycrystalline silicon in the integrated circuit and display industries.

Physics of Semiconductor Devices covers both basic classic topics such as energy band theory and the gradual-channel model of the MOSFET as well as advanced concepts and devices such as MOSFET short-channel effects, low-dimensional devices and single-electron transistors. Concepts are introduced to the reader in a simple way, often using comparisons to

everyday-life experiences such as simple fluid mechanics. They are then explained in depth and mathematical developments are fully described. Physics of Semiconductor Devices contains a list of problems that can be used as homework assignments or can be solved in class to exemplify the theory. Many of these problems make use of Matlab and are aimed at illustrating theoretical concepts in a graphical manner. Praise for CMOS: Circuit Design, Layout, and SimulationRevised Second Edition from the Technical Reviewers "A refreshing industrial flavor. Design concepts are presented as they are needed for 'just-in-time' learning. Simulating and designing circuits using SPICE is emphasized with literally hundreds of examples. Very few textbooks contain as much detail as this one. Highly recommended!" --Paul M. Furth, New Mexico State University "This book builds a solid knowledge of CMOS circuit design from the ground up. With coverage of process integration, layout, analog and digital models, noise mechanisms, memory circuits, references, amplifiers, PLLs/DLLs, dynamic circuits, and data converters, the text is an excellent reference for both experienced and novice designers alike." --Tyler J. Gomm, Design Engineer, Micron Technology, Inc. "The Second Edition builds upon the success of the first with new chapters that cover additional material such as oversampled converters and non-volatile memories. This is becoming the de facto standard textbook to have on every analog and mixed-signal designer's bookshelf." --Joe Walsh, Design Engineer, AMI Semiconductor CMOS circuits from design to implementation CMOS:

Circuit Design, Layout, and Simulation, Revised Second Edition covers the practical design of both analog and digital integrated circuits, offering a vital, contemporary view of a wide range of analog/digital circuit blocks, the BSIM model, data converter architectures, and much more. This edition takes a two-path approach to the topics: design techniques are developed for both long- and short-channel CMOS technologies and then compared. The results are multidimensional explanations that allow readers to gain deep insight into the design process. Features include: Updated materials to reflect CMOS technology's movement into nanometer sizes Discussions on phase- and delay-locked loops, mixed-signal circuits, data converters, and circuit noise More than 1,000 figures, 200 examples, and over 500 end-of-chapter problems In-depth coverage of both analog and digital circuit-level design techniques Real-world process parameters and design rules The book's Web site, CMOSedu.com, provides: solutions to the book's problems; additional homework problems without solutions; SPICE simulation examples using HSPICE, LTspice, and WinSpice; layout tools and examples for actually fabricating a chip; and videos to aid learning This volume describes the design of relay-based circuit systems from device fabrication to circuit micro-architectures. This book is ideal for both device engineers as well as circuit system designers, and highlights the importance of co-design across design hierarchies when trying to optimize system performance (in this case, energy-efficiency). The book will also appeal to researchers and engineers focused on

semiconductor, integrated circuits, and energy efficient electronics.

-- Projects include many program files in LabView, Mathcad and SPICE which professionals would not have time to create on their own.-- LabView allows engineers to turn their desktop into the instrument-- Analog circuit design is still vital in building communications devices - the addition of LabView makes this process more precise and time efficientThis book presents a study of analog electronics. It consists of theory and closely coupled experiments, which are based entirely on computer-based data acquisition using LabView. The topics included treat many of the relevant aspects of basic modern electronics.

This new text takes the reader from the very basics of analogue electronics to an introduction of state-of-the-art techniques used in the field. It is aimed at all engineering or science students who wish to study the subject from its first principles, as well as serving as a guide to more advanced topics for readers already familiar with the subject. Attention throughout is focused on measurable terminal characteristics of devices, the way in which these give rise to equivalent circuits and methods of extracting parameter values for them from manufacturers data sheet specifications. In the practical application of these equivalent circuits, step-by-step analysis and design procedures are given where appropriate. Throughout the book, emphasis is given to the pictorial representation of information, and extensive use is made of mechanical analogues. This, combined with the self-assessment questions, copious exercises and worked

examples result in an accessible introduction to a key area of electronics that even those with the most limited prior experience will find invaluable in their studies. Low-Voltage Low-Power Analog Integrated Circuits brings together in one place important contributions and state-of-the-art research results in this rapidly advancing area. Low-Voltage Low-Power Analog Integrated Circuits serves as an excellent reference, providing insight into some of the most important issues in the field.

For some time there has been a need for a semiconductor device book that carries diode and transistor theory beyond an introductory level and yet has space to touch on a wider range of semiconductor device principles and applica tions. Such topics are covered in specialized monographs numbering many hun dreds, but the voluminous nature of this literature limits access for students. This book is the outcome of attempts to develop a broad course on devices and integrated electronics for university students at about senior-year level. The edu cational prerequisites are an introductory course in semiconductor junction and transistor concepts, and a course on analog and digital circuits that has intro duced the concepts of rectification, amplification, oscillators, modulation and logic and SWitching circuits. The book should also be of value to professional engineers and physicists because of both, the information included and the de tailed guide to the literature given by the references. The aim has been to bring some measure of order into the subject area examined and to provide a basic structure from which teachers may develop themes that are of most interest to

students and themselves. Semiconductor devices and integrated circuits are reviewed and fundamental factors that control power levels, frequency, speed, size and cost are discussed. The text also briefly mentions how devices are used and presents circuits and comments on representative applications. Thus, the book seeks a balance be tween the extremes of device physics and circuit design.

Reliability concerns and the limitations of process technology can sometimes restrict the innovation process involved in designing nano-scale analog circuits. The success of nano-scale analog circuit design requires repeat experimentation, correct analysis of the device physics, process technology, and adequate use of the knowledge database. Starting with the basics, Nano-Scale CMOS Analog Circuits: Models and CAD Techniques for High-Level Design introduces the essential fundamental concepts for designing analog circuits with optimal performances. This book explains the links between the physics and technology of scaled MOS transistors and the design and simulation of nano-scale analog circuits. It also explores the development of structured computer-aided design (CAD) techniques for architecture-level and circuit-level design of analog circuits. The book outlines the general trends of technology scaling with respect to device geometry, process parameters, and supply voltage. It describes models and optimization techniques, as well as the compact modeling of scaled MOS transistors for VLSI circuit simulation. • Includes two learning-based methods: the artificial neural network (ANN) and the

least-squares support vector machine (LS-SVM) method • Provides case studies demonstrating the practical use of these two methods • Explores circuit sizing and specification translation tasks • Introduces the particle swarm optimization technique and provides examples of sizing analog circuits • Discusses the advanced effects of scaled MOS transistors like narrow width effects, and vertical and lateral channel engineering Nano-Scale CMOS Analog Circuits: Models and CAD Techniques for High-Level Design describes the models and CAD techniques, explores the physics of MOS transistors, and considers the design challenges involving statistical variations of process technology parameters and reliability constraints related to circuit design.

Device Electronics for Integrated CircuitsJohn Wiley & Sons

Im vorliegenden Buch wird die Technologie von hochintegrierten Schaltungen behandelt. Es werden zunächst sehr ausführlich und praxisnah die verschiedenen technologischen Verfahren und Einzelprozesse aus den Bereichen Lithographie, Schicht-, Ätz- und Dotiertechnik beschrieben. Danach folgen Beispiele für die Integration der Einzelprozesse zur Herstellung von CMOS-, Bipolar- und BICMOS-Schaltungen. Sowohl die Einzelprozesse als auch die Prozeßintegration sind anschaulich mit zahlreichen Bildern dargestellt. Das Buch vermittelt nicht nur eine gute Übersicht, sondern auch sehr detaillierte Informationen über den modernsten Stand der Technologie hochintegrierter Schaltungen, wie sie z.B. bei der Herstellung des dynamischen IMEGA-Bit-

Speichers Anwendung findet. Darüber hinausgehende Entwicklungen, die in den Sub-Mikrometer-Bereich führen, werden ebenfalls beschrieben.

Analog Integrated Circuits deals with the design and analysis of modem analog circuits using integrated bipolar and field-effect transistor technologies. This book is suitable as a text for a one-semester course for senior level or first-year graduate students as well as a reference work for practicing engin eers. Advanced students will also find the text useful in that some of the material presented here is not covered in many first courses on analog circuits. Included in this is an extensive coverage of feedback amplifiers, current-mode circuits, and translinear circuits. Suitable background would be fundamental courses in electronic circuits and semiconductor devices. This book contains numerous examples, many of which include commercial analog circuits. End-of-chapter problems are given, many illustrating practical circuits. Chapter 1 discuses the models commonly used to represent devices used in modem analog integrated circuits. Presented are models for bipolar junction transistors, junction diodes, junction field-effect transistors, and metal-oxide semiconductor field-effect transistors. Both large-signal and small-signal models are developed as well as their implementation in the SPICE circuit simulation program. The basic building blocks used in a large variety of analog circuits are analyzed in Chapter 2; these consist of current sources, dc level-shift stages, single-transistor gain stages, two-transistor gain stages, and output stages. Both bipolar and field-effect transistor implementations are presented.

Chapter 3 deals with operational amplifier circuits. The four basic op-amp circuits are analyzed: (1) voltage-feedback amplifiers, (2) current-feedback amplifiers, (3) current-differencing amplifiers, and (4) transconductance ampli fiers. Selected applications are also presented.
Die Arbeit beschäftigt sich mit der Reinigung und Gasphasenepitaxie in einem Ultrahochvakuum-Mehrkammersystem (UHV-Mehrkammersystem) für zukünftige CMOS-Technologien. Der Schwerpunkt der Arbeit liegt dabei in der Entwicklung von Prozessen für das „Kontakt- Engineering“ von Source- und Drain (S/D) für sub-100 nm MOSFETs. Mögliche Anwendungen liegen in der Implementierung von erhöhten S/D-Kontakten zur Erniedrigung der Source/Drain-Anschusswiderstände oder dem epitaktischen Auffüllen von S/D-Extension-Gebieten zur Minimierung von Kurzkanaleffekten. Im Rahmen dieser Arbeit wurde zum ersten Mal in einem Clustertool eine Wasserstoff-Plasmareinigung zur in-situ-LT-Reinigung von planaren oder vorstrukturierten Substraten mit UHV-CVD-Epitaxie kombiniert. Die Verwendung eines SiH4/GeH4-Prekursorengemisches erlaubt es, bei den typischen Prozessdrücken von 10?4 mbar bis 10?2 mbar auch ohne Chlorchemie selektive Abscheidung von Silizium und Silizium-Germanium-Legierungen zu gewährleisten. Insgesamt lässt sich damit ein Gesamtprozess inklusive Vorreinigung und selektiver Abscheidung (SEG) bei Temperaturen T ? 800 °C für die Si-UHV-CVD und T ? 600 °C für die SiGe-UHV-CVD etablieren. Die technologischen Rahmenbedingungen, welche in der Entwicklung eines selektiven LT-

Epitaxieprozesses ohne chlorierte Prekursoren in Kombination mit einer in-situ-LT-Reinigung in einem Clustertool gegeben sind, wurden damit voll erfüllt. Reinigung: Es wurden grundlegende Untersuchungen von verschiedenen UHV-kompatiblen Reinigungsverfahren, die sich durch unterschiedliche Temperaturbereiche und die Reinigungseffizienz unterscheiden, durchgeführt. Ergebnisse aus Untersuchungen zur thermischen Desorption im UHV (HT-Reinigung) konnten dabei auf die Wasserstoff-Plasmareinigung (LT-Reinigung) und die thermische Desorption in reaktiven Gasen (LT-Reinigung) umgesetzt werden. Das Hauptaugenmerk lag jeweils im Nachweis von Sauerstoff-, Kohlenstoff- und Stickstoff-Verunreinigungen. Es zeigt sich, dass die thermische Desorption (bei technologisch relevanten Temperaturen) im UHV äquivalent zur thermischen Desorption in Inertgasumgebungen, z. B. dem sog. H2-bake, ist. Die H2-Plasmareinigung ist mit einer maximalen Prozesstemperatur von ca. 225 °C eine LT-Reinigung. Es konnte erstmals nachgewiesen werden, dass die Ätzwirkung des Wasserstoffplasmas auf Oxid durch die Sputterwirkung von Ar -Ionen initiiert wird. Durch Ionenbeschuss wird das Oxid geschädigt und die obersten „Si?O“-Bindungen werden aufgebrochen. Durch die H-Radikale erfolgt schließlich ein ganzflächiger Oxidabtrag. Gasphasenepitaxie: Untersuchungen zur Morphologie von SiGe-Schichten haben gezeigt, dass sich im Gegensatz zur thermischen Desorption bei 900 °C mit H2-Plasmareinigung als Vorreinigung schon bei 500 °C mittels UHV-CVD glatte

SiGe- Schichten herstellen lassen. Aufbauend auf den Ergebnissen zur ganzflächigen Epitaxie von Si und SiGe mittels UHVCVD wurde die Selektivität bezüglich vorstrukturierter Oxid- und Nitridsubstrate untersucht. Die Inkubationszeit für das Poly-Wachstum auf Nitrid ist sehr viel geringer als für die Poly-Nukleation auf Oxid. Eine selektive Abscheidung von Si in Si-Fenstern von vorstrukturierten Nitridsubstraten ist für UHV-CVD bei 800 °C und thermischer Desorption als Vorreinigung daher nicht möglich. Weitere Untersuchungen haben gezeigt, dass die Inkubationszeit vom Silan- bzw. Germanpartialdruck abhängt. Zusätzlich wird das Nukleationsverhalten bei UHV-CVD und H2-Plasmareinigung als Vorreinigung durch die Plasmaparameter, z.B. der Plasmadauer, bestimmt. Prozesstechnisch kommt es bei Abscheidung im massentransportabhängigen Temperaturbereich bei Si-UHV-CVD (z. B. bei 800 °C) unabhängig von der Vorreinigung zu bekannten Effekten, wie dem „chemischen Loading-Effekt“ und dem Facettenwachstum von Si(111) und Si(311)-Mesaflächen. Beide Effekte sind prinzipiell unerwünscht. Zur elektrischen Charakterisierung der Kristallqualität von selektiv gewachsenen i-Si-Schichten wurden SEG-Mesen im Si-Fenster eines vorstrukturierten Oxidsubstrats gewachsen und zu einer nip-Diode prozessiert. Die bestimmte Volumendefektdichte entspricht der Dichte von ganzflächig abgeschiedenen intrinsischen Siliziumschichten. Glatte SiGe-Schichten mit einer ausreichenden maximalen selektiven Schichtdicke von

ca. 30 nm konnten schließlich mit SiGe-UHV-CVD bei 500 °C in Kombination mit der H2-Plasmareinigung als Vorreinigung hergestellt werden. Damit steht ein UHV-kompatibler Prozess zur Herstellung von vertikal erhöhten Source/Drain-Gebieten in planaren MOSFETs zur Verfügung. LP-CVD ist für die Abscheidung selektiver SiGe-Schichten nicht geeignet, weshalb bei industriellen RP-CVD-Prozessen SEG nur mit chlorierten Prekursoren bzw. durch Beimischung von HCl als Ätzgas funktioniert. Die Anwendung des Prozesses zur Herstellung eines epitaktischen Source/Drain-Anschlussgebietes eines MOSFETs der 90 nm Technologie wurde ebenfalls versucht. Das Ätzen der S/D-Extension erfolgt durch ein sequentielles H2-Plasmaätzen des Oxids mit anschließendem Si-Ätzen. Das Wiederauffüllen der freigeätzten Extensiongebiete ist aufgrund der gezeigten Selektivität zum Spacer-Material möglich. Abstract The dissertation deals with cleaning and gas phase epitaxy in an ultra high vacuum multi chamber system (UHV cluster tool) for future CMOS technologies. The emphasis of the work is the development and discussion of processes for the “contact engineering" of source and drain (S/D) for sub-100 nm MOSFETs. Appropriate applications focus on the implementation of elevated S/D contacts to reduce S/D contact resistances or an epitaxial refilling of S/D extensions to minimize short channel effects. In the context of this work for the first time a hydrogen plasma cleaning for the in-situ-LT-cleaning of planar or pre-structured substrates was combined with UHV-CVD epitaxy in a cluster tool. The use of a SiH4/GeH4

precursor gas mixture with typical process pressures of 10-4 mbar to 10-2 mbar ensures selective epitaxial growth of silicon and silicon germanium alloys even without chlorine chemistry. As a conclusion one can establish a full process including pre-cleaning and selective epitaxial growth (SEG) at temperatures T Silicon-on-Insulator Technology: Materials to VLSI, 2nd Edition describes the different facets of SOI technology. SOI chips are now commercially available and SOI wafer manufacturers have gone public. SOI has finally made it out of the academic world and is now a big concern for every major semiconductor company. SOI technology has indeed deserved serious recognition: high-temperature (400°C), extremely rad-hard (500 Mrad(Si)), high-density (16 Mb, 0.9-volt DRAM), high-speed (several GHz) and low-voltage (0.5 V) SOI circuits have been demonstrated. Strategic choices in favor of the use of SOI for low-voltage, low-power portable systems have been made by several major semiconductor manufacturers. Silicon-on-Insulator Technology: Materials to VLSI, 2nd Edition presents a complete and state-of-the-art review of SOI materials, devices and circuits. SOI fabrication and characterization techniques, SOI device processing, the physics of the SOI MOSFET as well as that of SOI other devices, and the performances of SOI circuits are discussed in detail. The SOI specialist will find this book invaluable as a source of compiled references covering the different aspects of SOI technology. For the non-specialist, the book serves as an excellent introduction to the topic with detailed, yet simple and clear explanations. Silicon-on-Insulator

Technology: Materials to VLSI, 2nd Edition is recommended for use as a textbook for classes on semiconductor device processing and physics. The level of the book is appropriate for teaching at both the undergraduate and graduate levels. Silicon-on-Insulator Technology: Materials to VLSI, 2nd Edition includes the new materials, devices, and circuit concepts which have been devised since the publication of the first edition. The circuit sections, in particular, have been updated to present the performances of SOI devices for low-voltage, low-power applications, as well as for high-temperature, smart-power, and DRAM applications. The other sections, such as those describing SOI materials, the physics of the SOI MOSFET and other devices have been updated to present the state of the art in SOI technology.

Electronics: Basic, Analog, and Digital with PSpice does more than just make unsubstantiated assertions about electronics. Compared to most current textbooks on the subject, it pays significantly more attention to essential basic electronics and the underlying theory of semiconductors. In discussing electrical conduction in semiconductors, the author addresses the important but often ignored fundamental and unifying concept of electrochemical potential of current carriers, which is also an instructive link between semiconductor and ionic systems at a time when electrical engineering students are increasingly being exposed to biological systems. The text presents the background and tools necessary for at least a qualitative understanding of new and projected advances in microelectronics. The author

provides helpful PSpice simulations and associated procedures (based on schematic capture, and using OrCAD® 16.0 Demo software), which are available for download. These simulations are explained in considerable detail and integrated throughout the book. The book also includes practical, real-world examples, problems, and other supplementary material, which helps to demystify concepts and relations that many books usually state as facts without offering at least some plausible explanation. With its focus on fundamental physical concepts and thorough exploration of the behavior of semiconductors, this book enables readers to better understand how electronic devices function and how they are used. The book's foreword briefly reviews the history of electronics and its impact in today's world. ***Classroom Presentations are provided on the CRC Press website. Their inclusion eliminates the need for instructors to prepare lecture notes. The files can be modified as may be desired, projected in the classroom or lecture hall, and used as a basis for discussing the course material.***

Offering a single volume reference for high frequency semiconductor devices, this handbook covers basic material characteristics, system level concerns and constraints, simulation and modeling of devices, and packaging. Individual chapters detail the properties and characteristics of each semiconductor device type, including: Varactors, Schottky diodes, transit-time devices, BJTs, HBTs, MOSFETs, MESFETs, and HEMTs. Written by leading researchers in the field, the RF and Microwave Semiconductor Device Handbook

provides an excellent starting point for programs involving development, technology comparison, or acquisition of RF and wireless semiconductor devices.
This book provides all the required information for a course in modern device electronics taken by undergraduate electrical engineers. It offers coverage of silicon technology, several topics in basic semiconductor physics, and Hall-effect sensors. The chapters on MOSFET focus on mobility variations and threshold-voltage dependence. Additional topics include VLSI devices, short channel effects, and computer modeling.· Semiconductor Electronics· Silicon Technology· Metal-Semiconductor Contacts· pn Junctions· Currents in pn Junctions· Bipolar Transistors I: Basic Properties· Bipolar Transistors II: Limitations and Models· Properties of the Metal-Oxide-Silicon System· Mos Field-Effect Transistors I: Physical Effects and Models· Mos Field-Effect Transistors II: High-Field Effects
Intuitive Analog Circuit Design outlines ways of thinking about analog circuits and systems that let you develop a feel for what a good, working analog circuit design should be. This book reflects author Marc Thompson's 30 years of experience designing analog and power electronics circuits and teaching graduate-level analog circuit design, and is the ideal reference for anyone who needs a straightforward introduction to the subject. In this book, Dr. Thompson describes intuitive and "back-of-the-envelope" techniques for designing and analyzing analog circuits, including transistor amplifiers (CMOS, JFET, and bipolar), transistor switching, noise in analog circuits, thermal circuit design, magnetic circuit design,

and control systems. The application of some simple rules of thumb and design techniques is the first step in developing an intuitive understanding of the behavior of complex electrical systems. Introducing analog circuit design with a minimum of mathematics, this book uses numerous real-world examples to help you make the transition to analog design. The second edition is an ideal introductory text for anyone new to the area of analog circuit design. Design examples are used throughout the text, along with end-of-chapter examples Covers real-world parasitic elements in circuit design and their effects