Uncertainty in key parameters within a chip and between different chips in the deep sub-micron area plays a more and more important role. As a result, manufacturing process spreads need to be considered during the design process. Quantitative methodology is needed to ensure faultless functionality, despite existing process variations within given bounds, during product development. This book presents the technological, physical, and mathematical fundamentals for a design paradigm shift, from a deterministic process to a probability-orientated design process for microelectronic circuits. Readers will learn to evaluate the different sources of variations in the design flow in order to establish different design variants, while applying appropriate methods and tools to evaluate and optimize their design. This book brings together innovative modelling, simulation and design techniques in CMOS, SOI, GaAs and BJTs to achieve successful high-yield manufacture for low-power, high-speed and reliable-by-design analogue and mixed-mode integrated systems. “Design For Manufacturing (DFM) is a TQM methodology by which inherently producible products can be manufactured with high yields, short turnaround time and great flexibility. The key to the success of any DFM program lies in increased accuracy in the modeling of the process and product designs, product simulations and effective manufacturing feedback of key parametric data. That is, properly modeling and simulating designs with data which reflects current fabrication capabilities has the most lasting influence in the performance of products. It is this area that is tackled in the methodology developed hereafter; a method by which to feedback and feedforward parametric data critical to the performance of Digital VLSI systems for performance prediction purposes. In this method, integrated circuit and applied statistics concepts are used jointly to perform analyses and inferences on response variables as a function of key processing and design variables that can be statistically controlled. Furthermore, an experimental design procedure utilizing electrical simulation is proposed to efficiently collect data and test previously proposed hypotheses. Conclusions are finally made with regard to the usefulness and outreach of this method, as well as those areas affected by the behavior of the performance predictors, both in the design and manufacturing stages of VLSI engineering.”--Abstract. "Offers a comprehensive, unified presentation of statistical designs and methods of analysis for all stages of pharmaceutical development--emphasizing biopharmaceutical applications and demonstrating statistical techniques with real-world examples. "The manufacturing yield, overkill, and defect level limit the feasibility of analog circuits in SoCs. The conventional method of handling process and environmental variation is to
assign a design margin such that the design meets specifications at several processes and environmental corners. However, checking only extreme corners limits performance in comparison to the more rigorous statistical approach of the computing manufacturing and quality figure of merit. The statistical approach requires transistor-level simulation of hundreds or even thousands of samples, not just a few corners, and thus is very time consuming. This research offers a method for reducing the time required for the statistical approach by characterizing each of the many samples of building blocks once at the transistor level. The building blocks are scalable such that the statistics are preserved when a building block is adjusted to the requirement of a higher-level design. Many design scenarios can be rapidly explored by assembling and scaling the building block samples without SPICE simulation. This study employs a continuous time low-pass filter design example to extract the requirements of the building block approach. The requirements include a method to assemble building blocks (biquad elements for the example) into a filter design. A selection of studies by professionals in the semiconductor industry illustrating the use of statistical methods to improve manufacturing processes. The book is a review of essential skills that an entry-level or experienced engineer must be able to demonstrate on a job interview and perform when hired. It will help engineers prepare for interviews by demonstrating application of basic principles to practical problems. Hiring managers will find the book useful because it defines a common ground between the student's academic background and the company's product or technology-specific needs, thereby allowing managers to minimize their risk when making hiring decisions. Ten Essential Skills contains a series of "How to" chapters. Each chapter realizes a goal, such as designing an active filter or designing a discrete servo. The primary value of these chapters, however, is that they apply engineering fundamentals to practical problems. The book is a handy reference for engineers in their first years on the job. Enables recent graduates in engineering to succeed in challenging technical interviews Written in an intuitive, easy-to-follow style for the benefit of busy students and employers. Book focuses on the intersection between company-specific knowledge and engineering fundamentals. Companion website includes interview practice problems and advanced material. Discover innovative tools that pave the way from circuit and physical design to fabrication processing Nano-CMOS Design for Manufacturability examines the challenges that design engineers face in the nano-scaled era, such as exacerbated effects and the proven design for manufacturability (DFM) methodology presents a comprehensive overview of methods that need to be mastered in understanding state-of-the-art design for manufacturability and statistical design methodologies. Broadly, design for manufacturability is a set of techniques that attempt to fix the systematic sources of variability, such as those due to photolithography and CME. Statistical design, on the other hand, deals with the random sources of variability. Both paradigms operate within a common framework, and their joint comprehensive treatment is one of the objectives of this book and an important differentiation. Explains the role of statistics in improving the quality of collecting and analyzing information for a wide variety of applications. The book examines the function of statisticians in quality improvement. It discusses statistical process control, quality statistical tables, and quality and warranty; quality standards in medicine and public health; Taguchi robust designs and survival models; and more. This book walks the reader through all the aspects of manufacturability and yield in a nano-CMOS process. It covers all
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CAD/CAE aspects of a SOC design flow and addresses a new topic (DFM/DFY) critical at 90 nm and beyond. This book is a must read book for the serious practicing IC designer and an excellent primer for any graduate student intent on having a career in IC design or in EDA tool development. This work presents the concepts of process design, problem identification, problem-solving and process optimization. It provides the basic tools needed to increase the consistency and profitability of manufacturing options, stressing the paradigms of improvement and emphasizing the hands-on use of tools furnished. The book introduces basic experimental design principles and avoids complicated statistical formulae. Covers the nuts, bolts, and statistics of implementing Six Sigma in electronics manufacturing--includes case studies and detailed calculations. This book is intended to introduce and familiarize design, production, quality, and process engineers, and their managers to the importance and recent developments in concurrent engineering (CE) and design for manufacturing (DFM) of new products. CE and DFM are becoming an important aspect of global competitiveness. The new product design and development life cycle has become the focus of many manufacturing companies as a road map to shortening new product introduction cycles, and to achieving a quick ramp-up of production volumes. Customer expectations have increased in demanding high-quality, functional, and user-friendly products. There is little time to waste in solving manufacturing problems or in redesigning products for ease of manufacture, since product life cycles have become very short because of technological breakthroughs or competitive pressures. Another important reason for the increased attention to DFM is that global products have developed into very opposing roles: either they are commodities, with very similar features, capabilities, and specifications; or they are very focused on a market niche. In the first case, the manufacturers are competing on cost and quality, and in the second they are in race for time to market. DFM could be a very important competitive weapon in either case, for lowering cost and increasing quality; and for increasing production ramp-up to mature volumes. Outlines best practices and demonstrates how to design in quality for successful development of hardware and software products. Offers systematic applications tailored to particular market environments. Discusses Internet issues, electronic commerce, and supply chain. Completely revised and updated to reflect the significant advances in pharmaceutical production and regulatory expectations, this third edition of Validation of Pharmaceutical Processes examines and blueprints every step of the validation process needed to remain compliant and competitive. The many chapters added to the prior compilation examine vaCD-ROM contains: Power Point presentations - Video clips - Quicktime movies.Knowledge exists: you only have to find it.VLSI design has become an important aspect of global competitiveness. The new product design and development life cycle has become the focus of many manufacturing companies as a road map to shortening new product introduction cycles, and to achieving a quick ramp-up of production volumes. Customer expectations have increased in demanding high-quality, functional, and user-friendly products. There is little time to waste in solving manufacturing problems or in redesigning products for ease of manufacture, since product life cycles have become very short because of technological breakthroughs or competitive pressures. Another important reason for the increased attention to DFM is that global products have developed into very opposing roles: either they are commodities, with very similar features, capabilities, and specifications; or they are very focused on a market niche. In the first case, the manufacturers are competing on cost and quality, and in the second they are in race for time to market. DFM could be a very important competitive weapon in either case, for lowering cost and increasing quality; and for increasing production ramp-up to mature volumes. Outlines best practices and demonstrates how to design in quality for successful development of hardware and software products. Offers systematic applications tailored to particular market environments. Discusses Internet issues, electronic commerce, and supply chain. Completely revised and updated to reflect the significant advances in pharmaceutical production and regulatory expectations, this third edition of Validation of Pharmaceutical Processes examines and blueprints every step of the validation process needed to remain compliant and competitive. The many chapters added to the prior compilation examine vaCD-ROM contains: Power Point presentations - Video clips - Quicktime movies.Knowledge exists: you only have to find it.
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the keys to success in the IC industry is getting a new product to market in a timely fashion and being able to produce that product with sufficient yield to be profitable. There are two ways to increase yield: by improving the control of the manufacturing process and by designing the process and the circuits in such a way as to minimize the effect of the inherent variations of the process on performance. The latter is typically referred to as "design for manufacture" or "statistical design". As device sizes continue to shrink, the effects of the inherent fluctuations in the IC fabrication process will have an even more obvious effect on circuit performance. And design for manufacture will increase in importance. We have been working in the area of statistically based computer aided design for more than 13 years. During the last decade we have been working with each other, and individually with our students, to develop methods and CAD tools that can be used to improve yield during the design and manufacturing phases of IC realization. This effort has resulted in a large number of publications that have appeared in a variety of journals and conference proceedings. Thus our motivation in writing this book is to put, in one place, a description of our approach to IC yield enhancement. While the work that is contained in this book has appeared in the open literature, we have attempted to use a consistent notation throughout this book. This book provides an introduction to statistical process control in automated manufacturing and suggests implementation strategies. It focuses on time series applications in statistical process control and explores the role of knowledge-based systems in process control. With more emphasis being placed on the cost and quality of new products and on reducing the lead time to develop them, attention is turning to the increasingly important topic of design for manufacturing (DFM). This involves the collaboration among research and development, manufacturing, and other company functions and is aimed at accelerating the new product development process from product conception to market introduction. A company can create a competitive advantage for itself by managing the process and its related organizational dynamics effectively. This collection of essays focuses on the development of strategic capabilities through use of DFM tools and practices, the role of DFM in specific product development phases, and the social, political, and cultural context within which DFM is introduced. One of the keys to success in the IC industry is getting a new product to market in a timely fashion and being able to produce that product with sufficient yield to be profitable. 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The second of two volumes in the Electronic Design Automation for Integrated Circuits Handbook, Second Edition, Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology thoroughly examines real-time logic (RTL) to GDSII (a file format used to transfer data of semiconductor physical layout) design flow, analog/mixed signal design, physical verification, and technology computer-aided design (TCAD). Chapters contributed by leading experts authoritatively discuss design for manufacturability (DFM) at the nanoscale, power supply network design and analysis, design modeling, and much more. New to This Edition: Major updates appearing in the initial phases of the design flow, where the level of abstraction keeps rising to support more functionality with lower non-recurring engineering (NRE) costs. Significant revisions reflected in the final phases of the design flow, where the complexity due to smaller and smaller geometries is compounded by the slow progress of shorter wavelength lithography. New coverage of cutting-edge applications and approaches realized in the decade since publication of the previous edition—these are illustrated by new chapters on 3D circuit integration and clock design. Offering improved depth and modernity, Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology provides a valuable, state-of-the-art reference for electronic design automation (EDA) students, researchers, and professionals. INTEGRATED CIRCUIT MANUFACTURABILITY provides comprehensive coverage of the process and design variables that determine the ease and feasibility of fabrication (or manufacturability) of contemporary VLSI systems and circuits. This book progresses from semiconductor processing to electrical design to system architecture. The material provides a theoretical background as well as case studies, examining the entire design for the manufacturing path from circuit to silicon. Each chapter includes tutorial and practical applications coverage. INTEGRATED CIRCUIT
MANUFACTURABILITY illustrates the implications of manufacturability at every level of abstraction, including the effects of defects on the layout, their mapping to electrical faults, and the corresponding approaches to detect such faults. The reader will be introduced to key practical issues normally applied in industry and usually required by quality, product, and design engineering departments in today's design practices: * Yield management strategies * Effects of spot defects * Inductive fault analysis and testing * Fault-tolerant architectures and MCM testing strategies. This book will serve design and product engineers both from academia and industry. It can also be used as a reference or textbook for introductory graduate-level courses on manufacturing. Most of the recent texts on compact modeling are limited to a particular class of semiconductor devices and do not provide comprehensive coverage of the field. Having a single comprehensive reference for the compact models of most commonly used semiconductor devices (both active and passive) represents a significant advantage for the reader. Indeed, several kinds of semiconductor devices are routinely encountered in a single IC design or in a single modeling support group. Compact Modeling includes mostly the material that after several years of IC design applications has been found both theoretically sound and practically significant. Assigning the individual chapters to the groups responsible for the definitive work on the subject assures the highest possible degree of expertise on each of the covered models. This book walks the reader through all the aspects of manufacturability and yield in a nano-CMOS process. It covers all CAD/CAE aspects of a SOC design flow and addresses a new topic (DFM/DFY) critical at 90 nm and beyond. This book is a must read book for the serious practicing IC designer and an excellent primer for any graduate student intent on having a career in IC design or in EDA tool development. Geometric tolerances are changing the way we design and manufacture industrial products. Geometric Tolerances covers their impact on the world of design and production, highlighting new perspectives, possibilities, current issues and future challenges. The topics covered are designed to be relevant to readers from a variety of backgrounds, ranging from product designers and manufacturers to quality inspection engineers and quality engineers involved in statistical process monitoring. Areas included are: • selection of appropriate geometric tolerances and how they stack up in assembled products; • inspection of parts subjected to geometric tolerancing from the macro to the micro and sub-micro scales; and • enhancement of efficiency and efficacy of quality monitoring. Geometric Tolerances provides the reader with the most recent scientific research in the field, as well as with a significant amount of real-life industrial case studies, delivering a multidisciplinary, synoptic view of one of the hottest and most strategic topics in industrial production. This book constitutes the refereed proceedings of the 20th International Conference on Integrated Circuit and System Design, PATMOS 2010, held in Grenoble, France, in September 2010. The 24 revised full papers presented and the 9 extended abstracts were carefully reviewed and are organized in topical sections on design flows; circuit techniques; low power circuits; self-timed circuits; process variation; high-level modeling of poweraware heterogeneous designs in SystemC-AMS; and miniologic. Proceedings of the Third IDMME Conference held in Montreal, Canada, May 2000. The book covers fundamental concepts, description, terminology, force analysis and methods of analysis and design. The emphasis in treating the machine elements is on methods and procedures that give the student competence in applying these to mechanical components in general. The book offers the students to learn to use the best available scientific understanding together with empirical information, good judgement, and often a degree of ingenuity, in order to produce the best product. Few unique articles e.g., chain failure modes, lubrication of chain drive, timing belt pulleys, rope lay selection, wire rope manufacturing methods, effect of sheave size etc., are included. Friction materials are discussed in detail for both wet and dry running with the relevant charts used in industry. Design of journal bearing is dealt exhaustively. Salient Features: " Compatible with the Machine Design Data Book (same author and publisher). " Thorough treatment of the requisite engineering mechanics topics. " Balance between analysis and design. " Emphasis on the materials, properties and analysis of the machine element. " Material, factor of safety and manufacturing method are given for each machine element. " Design steps are given for all important machine elements. " The example design problems and solution techniques are spelled out in detail. " Objective type, short answer and review problems are given at the end of each chapter. " All the illustrations are done with the help of suitable diagrams. " As per Indian Standards.