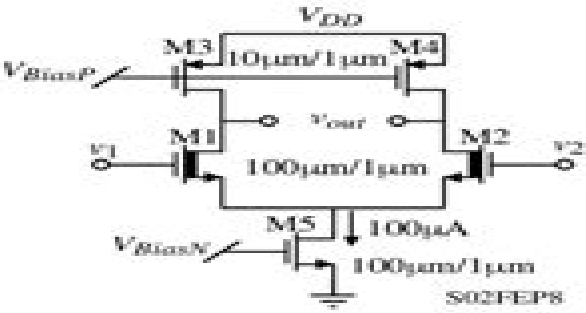
Homework Assignment No. 13

Due Friday, April 18, 2003 in class

Problem 1 - (10 points)

A differential CMOS amplifier using depletion mode input devices is shown. Assume that the normal MOSFETs parameters are $K_N' = 110\text{V}/\mu\text{A}^2$, $V_{TN} = 0.7\text{V}$, $\lambda_N = 0.04\text{V}^{-1}$ and for the PMOS transistors are $K_P' = 50\text{V}/\mu\text{A}^2$, $V_{TP} = -0.7\text{V}$, $\lambda_P = 0.05\text{V}^{-1}$. For the depletion mode NMOS transistors, the parameters are the same as the normal NMOS except that $V_{TN} = -0.5\text{V}$. (a.) What is the maximum input common-mode voltage, V_{icm}+(max)? (b.) What is the minimum input common-mode voltage, V_{icm}-(min)? (c.) What value of V_{DD} gives an $ICMR = 0.5V_{DD}$?



Problem 2 – (10 points)

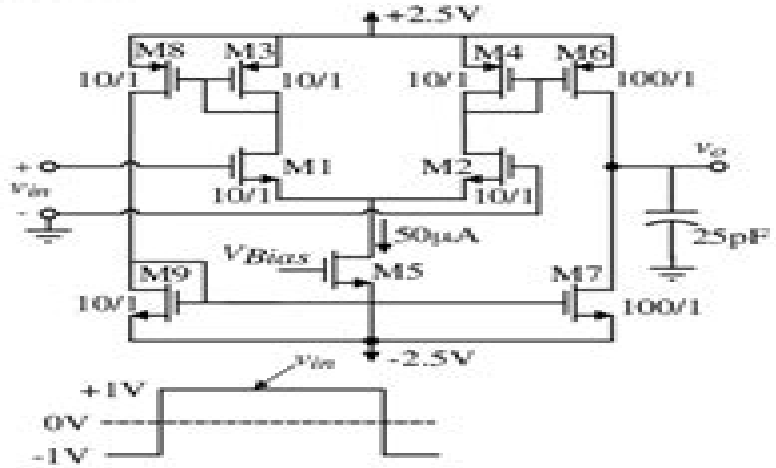
Problem 8.2-2 of Allen and Holberg, 2nd edition

Problem 3 – (10 points)

Problem 8.2-8 of Allen and Holberg, 2nd edition.

Problem 4 - (10 points)

The comparator shown has an input applied as shown. Assuming the the pulse width is wide enough, calculate the propagation delay time for this comparator. Assume that the trip point of the output is at 0V.



Analog Integrated Circuit Design Problem Answers

Ricardo Martins,Nuno Lourenço,Nuno Horta

Analog Integrated Circuit Design Problem Answers:

Analysis and Design of Analog Integrated Circuits Paul R. Gray,Paul J. Hurst,Stephen H. Lewis,Robert G. Meyer,2024-01-04 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS Authoritative and comprehensive textbook on the fundamentals of analog integrated circuits with learning aids included throughout Written in an accessible style to ensure complex content can be appreciated by both students and professionals this Sixth Edition of Analysis and Design of Analog Integrated Circuits is a highly comprehensive textbook on analog design offering in depth coverage of the fundamentals of circuits in a single volume To aid in reader comprehension and retention supplementary material includes end of chapter problems plus a Solution Manual for instructors In addition to the well established concepts this Sixth Edition introduces a new super source follower circuit and its large signal behavior frequency response stability and noise properties New material also introduces replica biasing describes and analyzes two op amps with replica biasing and provides coverage of weighted zero value time constants as a method to estimate the location of dominant zeros pole zero doublets including their effect on settling time and three examples of circuits that create doublets the effect of feedback on pole zero doublets and MOS transistor noise performance including a thorough treatment on thermally induced gate noise Providing complete coverage of the subject Analysis and Design of Analog Integrated Circuits serves as a valuable reference for readers from many different types of backgrounds including senior undergraduates and first year graduate students in electrical and computer engineering along with analog integrated circuit designers *CMOS Analog Circuit Design* Holberg Allen,Phillip E. Allen,Douglas R. Holberg,1995-06 After years of anticipation respected authors Phil Allen and Doug Holberg bring you the second edition of their popular textbook CMOS Analog Circuit Design From the forefront of CMOS technology Phil and Doug have combined their expertise as engineers and academics to present a cutting edge and effective overview of the principles and techniques for designing circuits Their two main goals are DT to mix the academic and practical viewpoints in a treatment that is neither superficial nor overly detailed andDT to teach analog integrated circuit design with a hierarchically organized approach Most of the techniques and principles presented in the second edition have been taught over the last ten years to industry members Their needs and questions have greatly shaped the revision process making this new edition a valuable resource for practicing engineers The trademark approach of Phil and Doug s textbook is its design recipes which take readers step by step through the creation of real circuits explaining complex design problems The book provides detailed coverage of often neglected areas and deliberately leaves out bipolar analog circuits since CMOS is the dominant technology for analog integrated circuit design Appropriate for advanced undergraduates and graduate students with background knowledge in basic electronics including biasing modeling circuit analysis and frequency response CMOS Analog Circuit Design Second Edition presents a complete picture of design including modeling simulation and testing and enables readers to design an analog circuit that can be implemented by CMOS technology FeaturesDT Orients the experience of the

expert within the perspective of design methodologyDT Identifies common mistakes made by beginning designersDT Provides problems with each chapter that reinforce and develop student understandingDT Contains numerous problems that can be used as homework quiz or exam problemsDT Includes a new section on switched capacitor circuitsDT Includes helpful appendices that provide simulation techniques and the following supplemental material A brief review of circuit analysis for CMOS analog designA calculator program for analyzing CMOS circuitsA summary of time frequency domain relationships for second order systems **CMOS Analog Circuit Design** Phillip E. Allen,Douglas R. Holberg,2012-07-19 This work presents an effective overview of the principles and techniques for designing circuits to be implemented in CMOS technology It explains the methodology of analogue integrated circuit design by using a hierarchically organised approach Analog Integrated Circuit Design Tony Chan Carusone,David Johns,Kenneth Martin,2011-12-13 When first published in 1996 this text by David Johns and Kenneth Martin quickly became a leading textbook for the advanced course on Analog IC Design This new edition has been thoroughly revised and updated by Tony Chan Carusone a University of Toronto colleague of Drs Johns and Martin Dr Chan Carusone is a specialist in analog and digital IC design in communications and signal processing This edition features extensive new material on CMOS IC device modeling processing and layout Coverage has been added on several types of circuits that have increased in importance in the past decade such as generalized integer N phase locked loops and their phase noise analysis voltage regulators and 1 5b per stage pipelined A D converters Two new chapters have been added to make the book more accessible to beginners in the field frequency response of analog ICs and basic theory of feedback amplifiers Analog Integrated Circuit Design Automation Ricardo Martins,Nuno Lourenço,Nuno Horta,2016-07-20 This book introduces readers to a variety of tools for analog layout design automation After discussing the placement and routing problem in electronic design automation EDA the authors overview a variety of automatic layout generation tools as well as the most recent advances in analog layout aware circuit sizing The discussion includes different methods for automatic placement a template based Placer and an optimization based Placer a fully automatic Router and an empirical based Parasitic Extractor The concepts and algorithms of all the modules are thoroughly described enabling readers to reproduce the methodologies improve the quality of their designs or use them as starting point for a new tool All the methods described are applied to practical examples for a 130nm design process as well as placement and routing benchmark sets **Computer-Aided Design of Analog Integrated Circuits and Systems** Rob A. Rutenbar,Georges G. E. Gielen,2002-05-06 The tools and techniques you need to break the analog design bottleneck Ten years ago analog seemed to be a dead end technology Today System on Chip SoC designs are increasingly mixed signal designs With the advent of application specific integrated circuits ASIC technologies that can integrate both analog and digital functions on a single chip analog has become more crucial than ever to the design process Today designers are moving beyond hand crafted one transistor at a time methods They are using new circuit and physical synthesis tools to design practical analog circuits new

modeling and analysis tools to allow rapid exploration of system level alternatives and new simulation tools to provide accurate answers for analog circuit behaviors and interactions that were considered impossible to handle only a few years ago To give circuit designers and CAD professionals a better understanding of the history and the current state of the art in the field this volume collects in one place the essential set of analog CAD papers that form the foundation of today s new analog design automation tools Areas covered are Analog synthesis Symbolic analysis Analog layout Analog modeling and analysis Specialized analog simulation Circuit centering and yield optimization Circuit testing Computer Aided Design of Analog Integrated Circuits and Systems is the cutting edge reference that will be an invaluable resource for every semiconductor circuit designer and CAD professional who hopes to break the analog design bottleneck *Parallel Solution of Integral Equation-Based EM Problems in the Frequency Domain* Y. Zhang,T. K. Sarkar,2009-06-29 A step by step guide to parallelizing cem codes The future of computational electromagnetics is changing drastically as the new generation of computer chips evolves from single core to multi core The burden now falls on software programmers to revamp existing codes and add new functionality to enable computational codes to run efficiently on this new generation of multi core CPUs In this book you ll learn everything you need to know to deal with multi core advances in chip design by employing highly efficient parallel electromagnetic code Focusing only on the Method of Moments MoM the book covers In Core and Out of Core LU Factorization for Solving a Matrix Equation A Parallel MoM Code Using RWG Basis Functions and ScaLAPACK Based In Core and Out of Core Solvers A Parallel MoM Code Using Higher Order Basis Functions and ScaLAPACK Based In Core and Out of Core Solvers Turning the Performance of a Parallel Integral Equation Solver Refinement of the Solution Using the Conjugate Gradient Method A Parallel MoM Code Using Higher Order Basis Functions and Plapack Based In Core and Out of Core Solvers Applications of the Parallel Frequency Domain Integral Equation Solver Appendices are provided with detailed information on the various computer platforms used for computation a demo shows you how to compile ScaLAPACK and PLAPACK on the Windows operating system and a demo parallel source code is available to solve the 2D electromagnetic scattering problems Parallel Solution of Integral Equation Based EM Problems in the Frequency Domain is indispensable reading for computational code designers computational electromagnetics researchers graduate students and anyone working with CEM software *Integrated Circuits MCQ (Multiple Choice Questions)* Arshad Iqbal, The Integrated Circuits Multiple Choice Questions MCQ Quiz with Answers PDF Integrated Circuits MCQ PDF Download Quiz Questions Chapter 1 2 Practice Tests with Answer Key Electronics Questions Bank MCQs Notes includes revision guide for problem solving with hundreds of solved MCQs Integrated Circuits MCQ with Answers PDF book covers basic concepts analytical and practical assessment tests Integrated Circuits MCQ PDF book helps to practice test questions from exam prep notes The Integrated Circuits MCQs with Answers PDF eBook includes revision guide with verbal quantitative and analytical past papers solved MCQs Integrated Circuits Multiple Choice Questions and Answers MCQs PDF Free download chapter 1 a book

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model but it can also select the most appropriate circuit topology and its respective sizing given the target specification The proposed methodology was implemented and tested on two analog circuit topologies **Scientific Computing in Electrical Engineering** Angelo Marcello Anile,Giuseppe Alì,G. Mascali,2007-01-10 This book is a collection of papers presented at the last Scientific Computing in Electrical Engineering SCEE Conference held in Sicily in 2004 The series of SCEE conferences aims at addressing mathematical problems which have a relevancy to industry The areas covered at SCEE 2004 were Electromagnetism Circuit Simulation Coupled Problems and General mathematical and computational methods

Advanced Techniques for Optimal Sizing of Analog Integrated Circuits Trang Hoang,Thinh Quang Do,Thang Quoc Nguyen,Hoang Trong Nguyen,Lihong Zhang,Octavia A. Dobre,Trung Q. Duong,2025-11-12 A novel and authoritative approach to quantum machine learning in integrated circuits design optimization In Advanced Techniques for Optimal Sizing of Analog Integrated Circuits Quantum Computing Machine Learning and Bio inspired Optimization a team of distinguished researchers deliver a comprehensive discussion of the theory models methodologies practical implementation and utilization of integrated circuit IC design The authors explain IC design optimization demonstrating cost effective and time saving design approaches as well as techniques likely to be impactful in the near future The book covers major topics in the field describing key concepts recent advances effective algorithms and pressing challenges associated with analog circuit sizing optimization It discusses using both animal and human inspired optimization algorithms to create basic and quantum machine learning methods Readers will also find A novel approach to quantum machine learning in integrated circuit design optimization A range of introductory and advanced topics suitable for students and advanced professionals and researchers Detailed illustrations that clarify abstract complicated engineering concepts Complete treatments of animal behavior inspired optimization algorithms including particle swarm optimization firefly algorithm cuckoo search bat algorithm Perfect for researchers in engineering computer scientists professors and senior undergraduate and graduate students in integrated circuit design this book will also benefit students of machine learning computer science quantum computing and optimization

SMART Integrated Circuit Design and Methodology Thomas Noulis,Costas Psychalinos,Alkis Hatzopoulos,2023-12-07 This book describes advanced flows and methodologies for the design and implementation of system on chip SoC It is written by a mixture of industrial experts and key academic professors and researchers The intended audience is not only students but also engineers with system on chip and semiconductor background currently working in the semiconductor industry Integrated Circuits are available in every electronic product especially in emerging market segments such as 5G mobile communications autonomous driving fully electrified vehicles and artificial intelligence These product types require real time processing at billions of operations per second The development design cycle time is driving costs and time to market more than ever before The traditional design methodologies have reached their limits and innovative solutions are essential to serve the emerging SoC design challenges In the framework of the Circuit and System Society CASS

Outreach Initiative 2022 call the SMART Integrated Circuits design methodology named SMARTIC Seasonal School was performed in November 2022 in Thessaloniki Greece Features Core analog circuits of any system of chip such as high performance rectifiers and filters are addressed in detail together with their respective design methodology New advanced methodologies towards design cycle speed up based on machine learning and artificial intelligence applications Advanced analog design methodology based on gm Id and lock up tables A powerful flow for enabling fast time to market analog circuit design focusing on baseband circuits More exotic methodologies and applications with focus on digital based analog processing in nanoscale CMOS ICs and the design and development of depleted monolithic active pixel sensors for high radiation applications together with all the respective challenges of this application *Integrated Circuit Design for Radiation Environments* Stephen J. Gaul,Nicolaas van Vonno,Steven H. Voldman,Wesley H. Morris,2019-12-31 A practical guide to the effects of radiation on semiconductor components of electronic systems and techniques for the designing laying out and testing of hardened integrated circuits This book teaches the fundamentals of radiation environments and their effects on electronic components as well as how to design lay out and test cost effective hardened semiconductor chips not only for today s space systems but for commercial terrestrial applications as well It provides a historical perspective the fundamental science of radiation and the basics of semiconductors as well as radiation induced failure mechanisms in semiconductor chips Integrated Circuits Design for Radiation Environments starts by introducing readers to semiconductors and radiation environments including space atmospheric and terrestrial environments followed by circuit design and layout The book introduces radiation effects phenomena including single event effects total ionizing dose damage and displacement damage and shows how technological solutions can address both phenomena Describes the fundamentals of radiation environments and their effects on electronic components Teaches readers how to design lay out and test cost effective hardened semiconductor chips for space systems and commercial terrestrial applications Covers natural and man made radiation environments space systems and commercial terrestrial applications Provides up to date coverage of state of the art of radiation hardening technology in one concise volume Includes questions and answers for the reader to test their knowledge Integrated Circuits Design for Radiation Environments will appeal to researchers and product developers in the semiconductor space and defense industries as well as electronic engineers in the medical field The book is also helpful for system layout process device reliability applications ESD latchup and circuit design semiconductor engineers along with anyone involved in micro electronics used in harsh environments *Computational Intelligence in Digital and Network Designs and Applications* Mourad Fakhfakh,Esteban Tlelo-Cuautle,Patrick Siarry,2015-07-14 This book explains the application of recent advances in computational intelligence algorithms design methodologies and synthesis techniques to the design of integrated circuits and systems It highlights new biasing and sizing approaches and optimization techniques and their application to the design of high performance digital VLSI radio frequency and mixed signal circuits and systems

This second of two related volumes addresses digital and network designs and applications with 12 chapters grouped into parts on digital circuit design network optimization and applications It will be of interest to practitioners and researchers in computer science and electronics engineering engaged with the design of electronic circuits Solution and Characteristic Analysis of Fractional-Order Chaotic Systems Kehui Sun,Shaobo He,Huihai Wang,2022-09-04 This book highlights the solution algorithms and characteristic analysis methods of fractional order chaotic systems Fractal dimensions exist broadly in the study of nature and the development of science and technology Fractional calculus has become a hot research area in nonlinear science Fractional order chaotic systems are an important part of fractional calculus The book discusses the numerical solution algorithms and characteristic analysis of fractional order chaotic systems and introduces the techniques to implement the systems with circuits To facilitate a quick grasp the authors present examples from their years of work in the appendix Intended for graduate students and researchers interested in chaotic systems the book helps one to build a theoretical and experimental foundation for the application of fractional order chaotic systems **GaAs MMIC Reliability - High Temperature Behavior** Aris Christou,Willie M. Webb,2006 *Nanoelectronic Coupled Problems Solutions* E. Jan W. ter Maten,Hans-Georg Brachtendorf,Roland Pulch,Wim Schoenmaker,Herbert De Gersem,2019-11-06 Designs in nanoelectronics often lead to challenging simulation problems and include strong feedback couplings Industry demands provisions for variability in order to guarantee quality and yield It also requires the incorporation of higher abstraction levels to allow for system simulation in order to shorten the design cycles while at the same time preserving accuracy The methods developed here promote a methodology for circuit and system level modelling and simulation based on best practice rules which are used to deal with coupled electromagnetic field circuit heat problems as well as coupled electro thermal stress problems that emerge in nanoelectronic designs This book covers 1 advanced monolithic multirate co simulation techniques which are combined with envelope wavelet approaches to create efficient and robust simulation techniques for strongly coupled systems that exploit the different dynamics of sub systems within multiphysics problems and which allow designers to predict reliability and ageing 2 new generalized techniques in Uncertainty Quantification UQ for coupled problems to include a variability capability such that robust design and optimization worst case analysis and yield estimation with tiny failure probabilities are possible including large deviations like 6 sigma 3 enhanced sparse parametric Model Order Reduction techniques with a posteriori error estimation for coupled problems and for UQ to reduce the complexity of the sub systems while ensuring that the operational and coupling parameters can still be varied and that the reduced models offer higher abstraction levels that can be efficiently simulated All the new algorithms produced were implemented transferred and tested by the EDA vendor MAGWEL Validation was conducted on industrial designs provided by end users from the semiconductor industry who shared their feedback contributed to the measurements and supplied both material data and process data In closing a thorough comparison to measurements on real devices was made in order to demonstrate the

algorithms industrial applicability EDA for IC Implementation, Circuit Design, and Process Technology Luciano Lavagno,Louis Scheffer,Grant Martin,2018-10-03 Presenting a comprehensive overview of the design automation algorithms tools and methodologies used to design integrated circuits the Electronic Design Automation for Integrated Circuits Handbook is available in two volumes The second volume EDA for IC Implementation Circuit Design and Process Technology thoroughly examines real time logic to GDSII a file format used to transfer data of semiconductor physical layout analog mixed signal design physical verification and technology CAD TCAD Chapters contributed by leading experts authoritatively discuss design for manufacturability at the nanoscale power supply network design and analysis design modeling and much more Save on the complete set **Electrical Engineering Problems and Solutions** Lincoln D. Jones,2003-09 This companion volume to Electrical Engineering License Review presents the main book s end of chapter problems with detailed step by step solutions A sample exam also with step by step solutions is included 100% problems and solutions

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Analog Integrated Circuit Design Problem Answers :

How can I be sure I won't be left behind in the rapture? Jan 4, 2022 — Those raptured "will be with the Lord forever" (1 Thessalonians 4:17). Believers in Jesus Christ are taken in the rapture; unbelievers will be ... Who will be saved on Judgment Day? Jan 31, 2022 — According to scripture (Revelation 20:11–15) all who refuse to receive the Lord Jesus Christ as Savior and Lord will be judged by God. The Book ... What Is the Tribulation? According to biblical prophecy, the Tribulation is a seven-year period that will begin immediately following the Rapture. Evil will spread without restraint ... What Is the Rapture? See What the Bible Says. Sep 21, 2017 — Then, second, after a period of seven years of tribulation on earth, Christ will return to the earth with His church, the saints who were ... Will Christians Go Through the Tribulation? Nov 4, 2020 — Many Christians believe that the 70th week (seven year period) described in Daniel 9:24-27 still awaits, and during this time, evil will reign ... The Second Coming of Christ | Moody Bible Institute This is not a judgment to determine their salvation but a reward for labor on Christ's behalf. The Rapture will also inaugurate a period that the Bible ... What Is the Judgment Seat of Christ? (The Bema) At some time in the future, the Lord will come back for those who have believed upon Him. He will change their bodies from corruptible to incorruptible. But we ... 6. The Future Judgment of the Believer Jun 14, 2004 — No believer will be judged at that day as the final judgment is reserved for all who rejected the Lord Jesus Christ on earth. The Judgment Seat ... God's Purpose for Israel During the Tribulation by TD Ice · 2009 · Cited by 2 — One of the major Divine purposes for the tribulation in relation to Israel is the conversion of the Jewish remnant to faith in Jesus as their Messiah.

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