

Analog IC Design – An Intuitive Approach

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4-Day Short Course

Intended Audience:

Integrated circuit (IC) design engineers, managers, and graduate students engaged and/or interested in expanding their knowledge on how to design, evaluate, specify, develop, and test analog integrated circuits.

Course Description and Objectives:

This course presents, discusses, and shows how to understand, develop, and use semiconductor devices to design analog integrated circuits (ICs). The underlying objective is to explain and illustrate how to model, analyze, and design analog ICs using bipolar, CMOS, and biCMOS process technologies. The material places emphasis on basic understanding and critical thinking, in other words, on intuitive grasp of how semiconductor devices work individually and collectively in microelectronic circuits. Ultimately, the course seeks to furnish the participant with a physical and intuitive view of solid-state circuits that transcends rigorous mathematical and algebraic formulations to empower the participant with the tools necessary to design innovative and complex ICs.

Outline:

1. Introduction
2. Microelectronic Devices
 - Passives: Resistors and Capacitors
 - Actives: Diodes, BJTs, MOSFETs, and JFETs
3. Single-Transistor Circuits
 - CE-CS Voltage Amplifiers
 - CC-CD Emitter/Source Voltage Followers
 - CB-CG Current Buffers
 - Physical Intuition to Analog IC Design
4. Analog Building Blocks
 - Differential Pairs
 - Current Mirrors
 - Five-Transistor Differential Amplifier
5. Negative Feedback
 - Generalities
 - Mixer
 - Sampler/Sensor
 - Stability
 - Frequency Compensation
6. Op Amps
 - Introduction
 - Two-Stage, Seven-Transistor Op Amp
 - Folded-Cascode Op Amp
 - Op-Amp Design Example
 - Simulations and Measurements
7. Power-Supply Rejection
 - Shunt-Feedback Model
 - Feed-Through Components
 - Two-Stage Op Amp
8. High-Performance Op Amps
 - Cascodes
 - Output Stages
 - Buffered Op Amps
 - High-Speed Op Amps

9. Comparators

Introduction

Open-Loop Comparators

Comparators with Hysteresis

Auto-Zeroed Comparators

10. Final Words

Instructor's Biography:

Prof. Gabriel A. Rincón-Mora received his B.S. from Florida International University (High Honors) and M.S. and Ph.D. from Georgia Tech (Outstanding Ph.D. Graduate). He worked for Texas Instruments in 1994-2003, was appointed Adjunct Professor for Georgia Tech in 1999-2001, and became a full-time faculty member in 2001. His scholarly products include 5 books and 1 book chapter, 26 patents, over 100 scientific publications, and 26 commercial power management chip designs. He received the "National Hispanic in Technology Award" from the Society of Professional Hispanic Engineers, the "Charles E. Perry Visionary Award" from Florida International University, a "Commendation Certificate" from the Lieutenant Governor of California, an IEEE Service Award from IEEE CASS MWSCAS, and "Orgullo Hispano" and "Hispanic Heritage" awards from Robins Air Force Base. He was inducted into the "Council of Outstanding Young Engineering Alumni" by Georgia Tech and featured on the cover of Hispanic Business Magazine as one of "The 100 Most Influential Hispanics," La Fuente (Dallas publication), and three times on Nuevo Impacto (Atlanta magazine). He was a Florida Undergraduate Scholar and a Florida International University Faculty Scholar.

Dr. Rincón-Mora is/was/has been an Associate Editor for IEEE's Transactions on Circuits and Systems II (TCAS II) since 2007; Circuit Design Vice Chair for IEEE's 2008 7th International Caribbean Conference on Devices, Circuits and Systems (ICCDCS); Chairman of Atlanta's joint IEEE Solid-State Circuits Society (SSCS) and Circuits and Systems Society (CASS) since 2005; member of IEEE's CASS Analog Signal Processing (ASP) Technical Committee since 2003; Steering Committee Member for IEEE's Midwest Symposium of Circuits and Systems (MWSCAS) since 2006; Technical Program Chair for IEEE's 2007 Joint MWSCAS-NEWCAS in Montreal; Technical Program Co-Chair for IEEE's 2006 MWSCAS in Puerto Rico; Vice Chairman of Atlanta's SSCS-CASS in 2004; and Selection Committee Review Panelist for the National Science Foundation (NSF) for 2003-2007. Dr. Rincón-Mora is a Senior Member of IEEE, a Life Member of the Society of Hispanic Professional Engineers (SHPE), and a Professional Member of IET. He is also a member of Eta Kappa Nu, Phi Kappa Phi, and a Life Member of Tau Beta Pi.

Dr. Rincón-Mora's research is on designing and developing energy and power efficient, high performance, totally integrated, system-on-chip (SoC) and system-in-package (SiP) power- and energy-conscious integrated circuit (IC) solutions for mobile and portable applications (e.g., energy harvesting, micro-scale fuel cells, thin-film lithium-ion batteries, inductor multipliers, etc.).