

EE 458: Analog VLSI Circuit Design

Semester: Fall 2011
Class Time: Tue. Thur. 11:00am-12:15pm.
Classroom: Dana Hall of Science, Room 109.
Instructor: Xingguo Xiong (Associate Professor)
Office: Tech 140.
Office Hours: Tue. Thur. 3:00pm-4:00pm, Wed. 4:30pm-5:30pm.
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Course Website: UB Blackboard, URL: <http://blackboard.bridgeport.edu/webapps/login/>

Description: Analog circuits are very important for the front and back ends to interface to the outside world. The system-on-chip (SoC) technology requires the implementation of both digital and analog modules on a single chip. The VLSI industry remains strong need for analog VLSI design engineers each year. The goal of this course is to introduce the modeling, design and analysis of analog CMOS VLSI. The students will design analog VLSI layouts, extract the netlists and simulate the circuit behavior. The transistor sizing in analog VLSI layouts will also be discussed.

Textbook: David Johns, Ken Martin, *Analog Integrated Circuit Design*, 1st edition, John Wiley & Sons, Inc., November 15, 1996, ISBN: 0471144487.

Reference: R. Jacob Baker, *CMOS: Circuit Design, Layout, and Simulation*, 2nd Edition, Wiley-IEEE Press, 11/2004, ISBN: 0-471-70055-X.
Neil H. E. Weste, Kamran Eshraghian, Michael John Sebastian Smith, *Principles of CMOS VLSI Design: A Systems Perspective with Verilog/VHDL Manual*, 2nd Edition, Addison Wesley Publishing Company, 2000, ISBN: 02017-3389-7.
Adel S. Sedra, and Kenneth C. Smith, *Microelectronics Circuits*, fourth edition, Oxford University Press, ISBN: 0-19-511690-9.
Phillip E. Allen and Douglas R. Holberg, *CMOS Analog Circuit Design*, Oxford University Press, 2002, ISBN: 01951-1644-5.
John F. Wakerly, *Digital Design: Principles and Practices*, 4th edition, July 27, 2005, Prentice Hall, ISBN: 0131733494.

Goals: Upon the completion of this course, the students will be able to design and analyze basic analog and mixed-signal CMOS VLSI circuits. They will get familiar with analog/mixed-signal VLSI circuits such as current sources and sinks, amplifiers, and ADC/DAC etc. They will be able to design analog VLSI layouts, decide transistor sizing, and simulate the designed VLSI circuits. They will also learn the skills of EDA tools such as PSPICE, Mentor Graphics tools, etc.

Prerequisites: Basic knowledge in microelectronics.

Topics:

1. Integrated-circuit devices and modeling
 - MOS transistors
 - Resistors, capacitors, MOSFET working principles and characteristics.
 - MOS device modeling
2. Processing and layout
 - CMOS processing
 - CMOS layout and design rules
3. Basic current mirrors and single-stage amplifiers.
 - Simple CMOS current mirror
 - Amplifiers.
 - Differential amplifiers.
 - Transistor sizing in analog VLSI.
4. Basic OPAMP design and compensation.
 - Two-stage CMOS OPAMP
 - Feedback and OPAMP compensation
5. Comparators
6. Sample and holds, voltage references, and translinear circuits.
7. Discrete-time signals.
8. Switched-capacitor circuits.
9. Data converter fundamentals (DAC/ADC architectures).
10. Nyquist-rate D/A and A/D converters.
11. Continuous-time filters

Grading: The final grade will be 15% on homework, 15% on projects, 31% on mid-term exam, 35% on final exam and 4% on attendance. There will be four times of random attendance, each will count 1 point in your final grade.

Exams There will be two exams: the mid-term exam and the final exam.

Computer Usage: Cadence OrCAD PSPICE, Mentor Graphics Tools, etc.

Lab Project: Several lab projects on VLSI design and simulation will be assigned. The goal of the projects is to help student accumulate skills and experience in analog VLSI design and simulation. Students will use EDA tools (Cadence OrCAD PSPICE, Mentor Graphics Tools, etc.) to design the VLSI circuits, and simulate its response. Software tutorials will be given before the project. Through the projects, students will get familiar with analog/mixed-signal VLSI design and simulation.

Cheating Policy: It is the student's responsibility to familiarize himself or herself with and adhere to the standards set forth in the policies on cheating and plagiarism as defined in Chapters 2 and 5 of the Key to UB (<http://www.bridgeport.edu/pages/2623.asp>) or the appropriate graduate program handbook.