

EE 491/591: Analog Circuits

(AKA Analog IC design)

Professor: Albert Titus

Office: 213 Bonner Hall

Class Meets: Tuesday and Thursday, 11 AM - 12:20PM in Knox 14

<http://www.eng.buffalo.edu/~ahtitus/Classes/>

Text: Design of Analog CMOS Integrated Circuits by Behzad Razavi (required)

UBlearns: The course material will be available on UBlearns. Go to MyUB (www.myub.buffalo.edu) to access UBlearns for this course. All class-related material and information is there.

Grading:

EE 491 (Undergraduates)		EE 591 (Graduates)	
Homework:	30%	Homework:	30%
Midterm:	20%	Midterm:	20%
Final Group Project:	40%	Final Group Project:	35%
Class Participation/Group Participation:	10%	Final Project Presentation:	15%

Homework:

These will be composed of problems dealing with the design, layout, and simulation of various components that will be discussed in class. The assignments will be posted on UBlearns. There will be four to five of these assignments, with due dates roughly every two weeks.

Midterms:

The first midterm exam will be held in class in the seventh or eighth week.

Final Project (group project):

The final project will be the design, simulation and layout of important circuits. These will be ready for fabrication. Details on the project will be provided beginning in week 2.

Final Project Presentation (Graduate Only):

These will be done at the end of the semester. Each group of graduate students will have to do a presentation on their project. Details will be posted later.

Schedule of Topics (This list is provided as a rough guide, deviations are likely):

Week	Topic	Chapter
1	MOSFET Device Physics, Layout and Fab	2
2	MOSFET Device Physics, Layout and Fab	2 & 17
3	MOSFET Single Stage Amplifiers	3
4	MOSFET Single Stage Amplifiers	3
5	MOSFET Single Stage Amplifiers	3
6	Differential Amplifiers	4
7	Differential Amplifiers	4
8	Current Mirrors and References	5
9	Current Mirrors and References	5
10	Frequency Response	6
11	Frequency Response	6
12	Amplifiers	9
13	Amplifiers	9
14	Stability, Compensation	10

Office Hours:

Office hours will be held on Tuesdays and Thursdays at 1:30PM – 2:30PM
My email is ahtitus@eng.buffalo.edu.

Books on Reserve at the UGL/SEL:

- Razavi, **Design of Analog CMOS Integrated Circuits**, McGraw Hill, 2000.
- Geiger, Allen, and Strader, **VLSI Design Techniques for Analog and Digital Circuits**, McGraw Hill, 1990.
- Gray and Meyer, **Analysis and Design of Analog Integrated Circuits**, 3rd edition and 4th ed. , John Wiley & Sons, 1993 and 2001.
- Maloberti, **Analog Design for CMOS VLSI Systems**, 1st edition, Kluwer, 2001.
- Hastings, **The Art of Analog Layout**, 2nd edition, Prentice Hall, 2006

Software:

Magic and SPICE3 (More information will be provided on the course website)
If you are unfamiliar with SPICE and/or UNIX, you should begin **immediately** learning these.

By the end of this course, you WILL be able to:

- Explain quantitatively and qualitatively how a MOSFET operates in a circuit
- Explain DC and small signal operation of MOSFET circuits
- Explain qualitatively MOSFETs' physical structure and how they are fabricated
- Do a mask-level layout of MOSFET circuits and extract those for simulation
- Use SPICE to perform simulations of MOSFET-based circuits
- Design MOSFET-based analog circuits (single and multiple transistor amplifier circuits) according to constraints such as power limits, size limits, speed limits, stability, and/or slew rate limits.

Other Important Information:**Penalties for Academic Dishonesty**

"The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect for others' academic endeavors.* By placing their name on academic work, students certify the originality of all work not otherwise identified by appropriate acknowledgments."

taken from <http://undergrad-catalog.buffalo.edu/0304/undergraduateeducation/strightslong.shtml>

* Adapted from the University of Wisconsin's Student Disciplinary Guidelines

Examples of academic dishonesty in this class include, for example:

- In exams or quizzes: Copying, providing aid to another student, obtaining or using aid from another student unless otherwise stated.
- In exams or quizzes: Copying or using any materials (books, magazines, papers, websites, people etc) not explicitly provided by the instructor or allowed by the instructor.
- Plagiarizing material from web sites
- Plagiarizing material from reports or project assignments that have been completed by another student in the course or by students who took the course in previous semesters
- Knowingly sharing solutions with another student (discussing problems is fine)
- If a student is found to have committed academic dishonesty, that student will receive a zero on the assignment, quiz, or exam. If the student is found to commit academic dishonesty a second time, the student will receive an "F" in the class.

(thanks to Dr. V. Paquet)

The above list is not exhaustive. If you have questions about plagiarism, please see examples at:

<http://www.princeton.edu/pr/pub/integrity/pages/plagiarism.html>

<http://www.northwestern.edu/uacc/plagiar.html>