

CMPE 447 : Analog Integrated Circuit Design.

University of Maryland Baltimore County, Spring 2016

I. COURSE DESCRIPTION

The course covers basic fundamentals of analog circuit design as they pertain to IC design. The focus will be on MOSFET technology, but BJTs will also be covered. Topics will include MOS and bipolar transistor devices along with their models and physical layout in ICs, current mirrors, single-transistor amplifiers, frequency response, differential amplifiers, feedback and stability, references, and noise analysis. The course will include design, simulation, and layout using industry-standard software.

II. COURSE DETAILS

A. Instructor

- Professor Ryan Robucci
- Department of Computer Science and Electrical Engineering
- ITE 316 Telephone x5-3549
- Email: robucci@umbc.edu
- Office Hours: TuTh 2:15-3:15. Other time is flexible and made available by email request.

B. Course Textbook

- Design of Analog CMOS Integrated Circuits, Behzad Razavi, Boston: McGraw Hill, 2001.
- other recommended texts will be listed on website

C. Logistics

- Course website can be found under <https://www.csee.umbc.edu/~robucci/>
- Meeting time: TuTh 1:00PM - 2:15PM

D. Prerequisites

- Required: CMPE 314, Electronic Circuits
- Recommended: Signals and Systems and VLSI Course

III. MAJOR LEARNING OBJECTIVES

- Describe models for active devices in MOS and Bipolar IC technologies
- Discuss layout considerations for active and passive devices in analog ICs
- Perform analysis and design of current mirrors and active loads
- Perform analysis and design single-transistor amplifiers
- Analyze frequency dependence in analog circuits
- Design differential circuits and amplifiers
- Analyze basic feedback topologies and effects on DC response and frequency response
- Incorporate design considerations for stability in feedback circuits
- Perform analysis and design of current sources and voltage references

- Identify noise sources in transistor and resistor models
- Perform analysis of circuit noise performance
- Design a multistage amplifier
- Enumerate and discuss basic operation of advanced analog and mixed-signal circuits

IV. COURSEWORK, GRADING, AND ASSESSMENT

Grading of students includes the following:

- Midterm Exams(2): 40%
- Final Exam 20%
- Homeworks/Assignments/Quizzes 40 %

A. Examinations

Midterm examinations will count for a total of 40%.

The final exam will count for 20%, and may include a at-home component in addition to the written exam during the final examination period.

There may be in-class quizzes, announced or unannounced, and be included in the 40%

90% or above is guaranteed an A ;
 $\geq 80\%:B; \geq 70\%:C; \geq 60\%:D.$

1) *Make-up Examinations:* If an exam is missed without a really good excuse, the grade is a zero. If the exam is missed with a really good excuse and the instructor is notified in advance, there may be a make-up exam administered or the average score of the other exams may be used, at the instructor's option.

B. Homeworks/Assignments

Students will perform regular homeworks. Though homeworks are used to assess the progress of the students, they are primarily for self-assessment and interactive learning. Homeworks are valuable as a learning experience and I emphasize that more than the assessment aspect. For instance, assistance and even answers are sometimes provided for some homework problems. Homeworks will involve book-type problems as well as simulation-based experimentation and design. This encourages traditional theoretical study and learning, as well as learning through design and true problem solving. Homeworks are intended to teach and encourage extra study. It is expected that students will require the professor guidance to complete some assignments. This encouraged opportunity for interaction with the professor provides for a better learning experience and allows the teacher to evaluate comprehension and make adjustments to the teaching material. Discussion with other students is allowed and encouraged **unless otherwise stated**, but work handed in from any student must be representative of that student's learning and understanding. Cheating certainly includes turning in work representative of someone else's efforts that you don't understand, can't justify, can't explain, and can't reproduce.

C. Incomplete Grades

A grade of incomplete will be given only under exceptional circumstances described by the University policy for granting incompletes. Any such circumstance MUST be brought to the instructor's attention immediately as soon as it is known. Failure to complete assignments on time is not a sufficient reason for an incomplete. If you feel you are falling behind, seek help immediately.

D. Final Grading

If you feel you are falling behind, seek help immediately. There will be no provision for extra projects or other attempts to improve a grade after the semester. Your grade is based on performance during the semester in this class. Requests after the semester asking to reconsider judgment for your grades will not be accepted except in extreme and unusual circumstances or if you think there is an accounting error. I can assure you I give an extreme amount of consideration and care before final grade assignment. It is not a fair practice for me to selectively reevaluate and change grades.

E. Academic Misconduct

All students are expected to be knowledgeable on all University policies on academic misconduct. All work a student presents, both homework and exams, must be his or her own exclusively unless otherwise directed. Any cheating or plagiarism will not be tolerated, and will subject the student to a grade of F or worse, without any warnings. Any false or misleading representations to the instructor will also be considered as academic misconduct. By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty and they are wrong. Academic misconduct could result in disciplinary action that may include suspension or dismissal. To read the full policy on academic integrity, consult the UMBC Student Handbook, Faculty Handbook or the UMBC Policies section of the UMBC Directory.

V. TENTATIVE SCHEDULE

Week	Topics	Reading
1	Introduction, Bipolar and MOS Devices	Ch 1, Ch 2
2	Bipolar and MOS Devices	Ch 2
3	Single Stage Amplifiers	Ch 3
4	Single Stage Amplifiers	Ch 3
5	Differential Amplifiers	Ch 4
6	Current Mirrors, Exam #1	Ch 5
7	Current Mirrors, Frequency Response	Ch 5, Ch 6
8	Frequency Response, Feedback	Ch 6, Ch 8
9	Feedback and Stability, OP Amps	Ch 8, Ch 10, Ch 9
10	OP Amps	Ch 9
11	Sample and Hold, Intro To {Switch Cap, Gm filters, Data Converters}	Ch 12, GmC Notes, Data Converter Notes
12	Compensation	Ch 10
13	Bandgap References, Exam #2	Ch 11
14	Mismatch, Noise	Ch 13, Ch 7
15	Additional Topics/Review	
	Final Exams	