

EE 507 – VLSI COMMUNICATION CIRCUITS

IOWA STATE UNIVERSITY DEPT. OF ELECTRICAL AND COMPUTER ENGINEERING

Required Text: Behzad Razavi, RF Microelectronics

Optional Text: Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Ed.

Instructor:

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Office: 2132 Coover Hall
Office Hours: **TBD**

Prerequisites: EE 330 or EE 501 (If you are unsure if you meet the prerequisite requirements or would like to take the course despite not meeting the requirements, please see the professor to discuss your situation)

Course Description

The primary goal of this class is to analyze and design radio frequency integrated circuits (RFICs) for wireless and wired communications. The course will begin with an overview of wireless technology and a discussion of fundamental concepts in RF design such as nonlinearity, sensitivity, and dynamic range. The discussion will then move towards matching and impedance transformation networks as well as noise in integrated circuits. In addition to transceiver architectures, the remainder of the course will concentrate on the detailed analysis and design of common RF building blocks including: low-noise amplifiers, mixers, oscillators, frequency synthesizers, and power amplifiers.

Homework

There will be approximately ten homework assignments. Homework will be assigned on Mondays and be due at the beginning of lecture on the following Monday, unless otherwise noted. While it is encouraged to collaborate with other students, direct copying is not permitted and each student must turn in his or her own complete assignment.

Lab

There will be a laboratory associated with this class. A 3-hour weekly meeting time will be decided upon during the first week of class. Labs will take place in Coover 2046 and Coover 3014 but will not necessarily meet every week and the first meeting time will be announced in class. The laboratory section of this class will consist of two separate components: a design component and an RF measurement/test component.

The design component will consist of three separate design projects that, when combined, will constitute a down-conversion chain for a radio-frequency receiver. Students will work individually and will be asked to design a low-noise amplifier, mixer, and voltage-controlled oscillator. Each project will be designed using transistor models from a commercially available 130 nm CMOS process. For circuit design and simulation we will be using Cadence, which is available on campus for use by students.

The measurement component will consist of students working in small groups of two or three to fully characterize an amplifier, mixer, oscillator, and complete receive chain. Students will learn how to perform linearity, noise figure, and gain measurements for RF amplifiers and mixers as well as how to measure phase noise, tuning range, and spectral purity for RF oscillators.

After each laboratory exercise, a written lab report will be required. For group work, only one report is required per group. Lab reports will be due one week after the completion of the associated lab assignment. Since the laboratory section is a vital part of learning about RFIC design, a passing grade in the laboratory is required for a passing grade in the class. Detailed project descriptions for each project will be posted to the web.

Exams

There will be one in-class midterm exam and one final exam for this class. The date and time of the final exam depends on the registrar's schedule. Both exams will take place in the normal class meeting room. Students will be allowed to bring one page of notes to the midterm and two pages of notes to the final exam (one page is one 8.5" x 11" sheet of paper, front and back). Otherwise, both exams will be closed book, closed note. The use of any wireless devices is strictly prohibited during exams. Making up a missed exam will only be considered in extreme circumstances of which the professor must be notified prior to the actual exam.

Grading

- Homework Assignments: 20%
- Lab: 30%
- Midterm Exam: 20%
- Final Exam: 30%

Late Policy

No late homework assignments or lab reports will be accepted without prior approval from the professor.

Students with Disabilities

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon. Please request that a Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.