ENGR 2420: Introduction to Microelectronic Circuits

January 22, 2020

Instructor: Bradley A. Minch

Office: MH 354 Tel: 781-292-2566
Office Hours: by appointment E-mail: bradley.minch@olin.edu

Class Meetings: TF 9-10:40 AM, T 1-2:30 PM (Lab) in AC 309

Credits: 4 ENGR

Hours: 4-4-4

Prerequisites: ENGR 1125 or permission of instructor

Course Description:

This course will cover elements of linear circuits, such as the operation of basic circuit elements, fundamental circuit laws, and analytic techniques in both the time domain and the frequency domain. It will also cover the transistor-level design of bipolar and complementary metal-oxide-semiconductor (CMOS) electronic circuits in the context of modern integrated-circuit technology. The course will include an introduction to the structure and operation of bipolar and metal-oxide-semiconductor (MOS) transistors and to the design and operation of the basic building blocks of analog integrated circuits including single-transistor amplifier stages, current mirrors, cascodes, differential pairs, and single-stage operational amplifiers. Throughout the course, an emphasis will be placed on design-oriented circuit analysis techniques and developing circuit reasoning skills.

Course Web Page: http://madvlsi.olin.edu/circuits

Grades: 100% Labs.

There will be 9 or 10 labs during the semester, approximately one per week. Each lab will generally consist of a prelab assignment, an experimental section, and a postlab assignment. You are to complete the prelab assignments individually before you start working on the experimental portion of the lab; your solution to the prelab section of any given lab will generally be due at the beginning of the lab section in which you start that lab. This part will typically be worth 20% of your lab grade. You will generally work in groups of two students on the experimental section of the lab, although if there happens to be an odd number of students in the class, a group of three is fine. No one should be working alone on the experimental section of the labs. Each group will be responsible to submit a single joint written report providing the results of your experiments, procedural details, observations, reflections, and responses to any specific questions posed in the lab handout. The joint report for a given lab will generally be due at the beginning of the Tuesday class of the week after the lab is done and will be worth 60% of your lab grade. As with the prelab section, you are to complete the postlab individually. It will also generally be worth 20% of the lab grade and will be due at the same time as your joint written report. To determine your course grade, I will average all of your lab grades. If your average is 90% or higher, you will receive at least an A-. If your weighted average is 80% or higher, you will receive at

least a B-. If your weighted average is 70% or higher, you will receive at least a C-. I may adjust the boundaries between letter grades down, depending on the distribution of overall weighted averages. No individual assignments will be curved.

Learning Objectives: At the end of this course, students will:

- Understand the operation of basic linear circuit elements, such as the voltage source, current source, resistor, capacitor, and the operational amplifier.
- Understand basic circuit laws, principles, and theorems.
- Be able to analyze linear circuits in the time domain and in the frequency domain.
- Understand the operation of the bipolar transistor and of the MOS transistor at all levels of inversion.
- Be able to identify subunits commonly used in analog integrated circuits, such as single-transistor amplifiers, cascodes, current mirrors, and differential pairs.
- Be able to determine qualitatively both the quiescent operating point of a bipolar or CMOS electronic circuit and the response of the circuit to a disturbance.
- Be able to quantitatively analyze the response of a bipolar or CMOS circuit to small-signal disturbances.

Text:

There is no required textbook for this course. For some topics, I will be distributing detailed notes as we go along. Our approach to the course material will be sufficiently different from that taken in most texts that none of them would have been suitable for use as a course text.

Course Policies:

Collaboration. You are free to discuss the prelab and postlab problems with other students in the class, but when it comes time to write your final solutions to these parts of the lab reports, your work should be yours alone. You may not simply copy someone else's solution. You should have a sufficient understanding of everything that you write down that you could explain it to someone else (e.g., me) and answer his or her questions about it without consulting anyone else. You are also free to seek help from your classmates to diagnose problems with your experimental set-ups. However, you may not turn in another group's experimental data in your lab report, even with proper attribution.

Late Assignments. Late assignments will generally be penalized at a rate of 5% per day or fraction thereof up to a maximum of 50%. If an assignment solution has been posted to the course web site before you have turned in an assignment, you may not consult it and alter your solution; I will consider such actions as a violation of the honor code and deal with them accordingly.

Past Assignment Solutions. You may not consult any of the prelab or postlab solutions from any past offering of this class at any time during this semester. I will consider such actions an honor code violation.