COURSE INFORMATION

Instructor:

Professor Clark Nguyen, 574 Cory Hall, Tel: (510)642-6251
e-mail address: ctnguyen@eecs.berkeley.edu

Office Hours: Tu 1:30-3 p.m., Th 8:30-10 a.m. (to be modified in case of conflicts)

Lecture: Monday, Wednesday 9:00-10:30 a.m. in 299 Cory Hall

Office Hours:

Office hours are the primary mechanism for individual contact with Professor Nguyen. All students are strongly encouraged to make use of office hours.

Course Description:

Integration density and performance of analog and digital integrated circuits have undergone an astounding revolution in the last couple of decades. Over this time period, clock frequencies of microprocessors have doubled every three years, and they show no signs of slowing down. For both logic IC’s and memories, integration complexity and density has doubled every 1 to 2 years. Although innovative circuit and system design can account for some of these performance increases, technology has been the main driving force. This course will examine the process technology that has enabled the integrated circuit revolution and investigate new technologies and layout/circuit techniques aimed at sustaining the current rate of progress in integrated circuits. The goal is to achieve a working knowledge of the driving and limiting factors in circuit performance, of the fabrication and design techniques that influence performance, and of likely future trends. The course emphasizes the physical principles and mathematical models used to characterize fabrication and inspection processes in microfabrication technology.

There will be two hour-and-a-half lectures per week. The lectures will be supplemented by reading assignments (indicated on the COURSE SYLLABUS), additional reading material to be distributed throughout the course, problem sets (one per week, occasionally per two weeks), one midterm exam, a project, and a final exam. Although the material covered in the lectures and in the reading is fundamentally the same, the perspectives differ, and you are all strongly encouraged to both attend the lecture and complete your reading assignments. Furthermore, there will be occasional announcements in lectures that will affect your problem sets and exams.

Lectures, 3 credit hours.

Prerequisites:

EE 143 and either EE 140 or EE 141, each of which in turn required EE 105. It is assumed that you are familiar with the following topics:

1) Basic solid-state device design, operation, physics, and fabrication (EE 105 and 143): diodes, bipolar junction transistors, and MOS field-effect transistors, and methods for their wafer-level fabrication. You should have a working familiarity with integrated circuit processing techniques, including oxidation, diffusion, ion implantation, epitaxy, deposition, and etching.
2) **Transistor level** design of amplifiers and operational amplifiers (EE 140), including active loads, biasing, frequency response, settling, stability, differential offsets, power supply rejection, and feedback.

3) **Transistor level** design and analysis of common digital circuits (EE 141), including logic circuits (e.g., inverters, NOR/NAND, and similar gates) and simple memory structures (e.g., flip-flops). An understanding of latch-up will particularly be useful.

The above prerequisites are not to be taken lightly! Be forewarned: this course will be taught under the premise that you understand the above material. There will be some review of EE 143 material, but little or no review of the other topics. To aid you in determining whether or not you have the required background, please consult the online syllabi of the above courses.

**Texts:**

**Required:** Plummer, Deal, and Griffin, *Silicon VLSI Technology: Fundamentals, Practice, and Modeling*

Various material to be distributed throughout the course.

**Supplementary:** Jaeger, *Introduction to Microelectronic Fabrication (Vol. V of the Modular Series on Solid State Devices), 2nd Edition*

**References:** (on reserve)

- Box, Hunter and Hunter, *Statistics for Experimenters*
- Sheats and Smith, *Microlithography Science and Technology*
- Levinson, *Principles of Lithography*
- Wong, *Resolution Enhancement Techniques in Optical Lithography*
- Mack, *Inside Prolith*
- P. Rai-Choudhury (Editor), *Handbook of Microlithography, Micromachining, and Microfabrication, Vol.1: Microlithography*

**Reading Assignments:**

Reading assignments include sections of the required textbook, distributed readings, and supplementary notes handed out in lecture. Reading assignments are indicated in the COURSE SYLLABUS and will also be included in problem assignments where appropriate. Supplementary notes will be handed out for topics where lecture coverage is substantially different from the textbook. Students are responsible for all material in the reading. In particular, the scope of coverage for problem sets, the midterm, the project, and the final examination includes the reading assignments as well as lecture material.

**Problem Sets:**

Problem sets will be issued on Mondays and for most cases are due at the end of class on the following Monday (no late homeworks will be accepted). There will occasionally be assignments for which two weeks will be required; these will also normally be due at the end of class on Mondays. Solutions will be handed out in class.
Project:

A project will be assigned during the latter half of this course. During this period, the homework load will be smaller, and assignments will be designed to aid you in completing the project.

Midterm:

The approximate date of the midterm exam in this course is indicated in your COURSE SYLLABUS. We will try to adhere to this date so much as possible. The midterm will be a 1.5 hour exam.

Final Exam:

The final exam will take place during the Examination period as indicated in your Time Schedules, and will cover all of the material in the course. This includes everything covered in problem sets, lectures, and readings.

Computer Accounts/CAD Tools:

All CS and EE students can have “named” accounts on the EECS instructional computers, which include UNIX, Windows, and MacOSX platforms. Matlab runs on all of them. Students can use the computer labs in 199, 105 and 119 Cory, or in other labs listed in the link:

http://inst.eecs.berkeley.edu/~inst/iesglabs.html

Most of you should already have computer accounts that work in those labs. If not, then you can get a “named” account by going to following link:

http://inst.eecs.berkeley.edu/connecting.html#accounts

and following the instructions (which entail going to 199 Cory and logging in as “newacct” with password “newacct”, among other things). You will need to wait 24 hours after you log on and create your account before coming to see Loretta, who will take care of the rest of the process.

Once you create your account, you should have access to all of the necessary software for your course work.

Grading Policy:

Course grades will be assigned according to the following grading formula.

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Problem Sets:</td>
<td>20%</td>
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<tr>
<td>Project:</td>
<td>25%</td>
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<tr>
<td>Midterm Exam:</td>
<td>20%</td>
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<tr>
<td>Final Exam:</td>
<td>35%</td>
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