



ECE 4590/6590 Integrated Circuit Design

FALL 2020

MEETING TIME: MWF 2:30-3:20 p.m.

MEETING LOCATION: Daniel Hall 401

INSTRUCTOR: Yingjie Lao (ylao@clermson.edu)

OFFICE HOURS AND PROCEDURES: virtual office hour Mon/Wed 3:20pm-4:30pm or by appointment

COURSE MODALITY: Hybrid

COURSE DESCRIPTION: Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries, custom and semicustom integrated circuits; computer-aided design software/hardware trends and future developments; hands-on use of CAD tools to design standard library cells; systems design considerations, testing, and packaging.

COURSE PREREQUISITES: Students are expected to have completed a course comparable to ECE 3210 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 3110 or MATH 4340 when enrolling in this course. Coreq: ECE 6591.

STUDENT LEARNING OUTCOMES: At the completion of the course, students should be able to understand the transistor-level and logic-level aspects of integrated circuit (IC), and design digital VLSI circuits. Besides, students should be familiar with Synopsys Computer-Aided Design (CAD) tools that are the de-facto design software in the semiconductor industry.

REQUIRED MATERIALS: N. Weste and D. Harris, "CMOS VLSI Design", Addison-Wesley/Pearson, 4th edition, 2011. ISBN: 0321547748.

RECOMMENDED MATERIALS:

J. M. Rabaey, "Digital Integrated Circuits: A Design Perspective", Prentice-Hall, 2nd edition, 2003, ISBN: 0130909963.

S. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits", McGraw Hill, 4th edition, 2014. ISBN: 0073380628.

Student is required to have a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone.

TOPICAL OUTLINE (SUBJECT to CHANGE):

- IC Design Flow (1 week)
- CMOS Device Physics and Models (1.5 weeks)
- Basics of CMOS Circuits: Basic Gates, Combinational and Sequential Logic (2.5 weeks)
- Delay Calculation and Optimization (1.5 weeks)
- Designing Wires (1.5 weeks)
- Dynamic Styles: Domino and Pass Transistor Logic (1 week)
- Logic Design: Adders and Multipliers (2 weeks)
- SPICE Simulation (2 weeks)
- Verilog Hardware Description Language (2 weeks)

CLASS CANCELLATION POLICY: Every attempt will be made to announce class cancellations in advance. A time for make-up lectures will be determined. Students may leave after 15 minutes if no one shows up to teach a class.

GRADING POLICY:

All exams will be online, open book, open notes. Details of test procedures will be provided in Canvas announcements.

Undergraduate:

- 20% Homework - no late homework, no copying!
- 40% Lab & Project
- 20% Midterm Exam
- 20% Final Exam

Graduate:

- 20% Homework - no late homework, no copying!
- 50% Lab & Project (graduate students are required to complete more projects)
- 15% Midterm Exam
- 15% Final Exam

A 100% scale will be used.

A – 85%-100%; B – 75-85%; C – 65-75%; D – 60-65 & F – < 60% (Undergraduate)

A – 85%-100%; B – 75-85%; C – 65-75%; & F – < 65% (Graduate)

I reserve the right to curve test scores in situations that I deem warrant such. Curving test scores is NOT a given.

ATTENDANCE POLICY:

1. The university will assign students a day of the week they are to come this class; on other days, they must attend online.
2. Attendance is optional on days students are to come physically.
3. Online attendance is optional, but strongly recommended.
4. Exams must be taken on the date and time as scheduled. A student absent from a test will receive a grade of 0 for that test. In case of compelling reasons (as judged by the instructor), the instructor will make an effort to accommodate the student, but this should be a last resort. Note: valid excuses MUST be presented to the instructor before or within three days of the missed test or exam. No exceptions will be accepted. Any exam that was scheduled at the time of a class cancellation will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the cancellation.
5. Students can use the Notification of Absence module in Canvas or email to inform the instructor of student absences.
6. To maintain physical distancing, individuals arriving first to the classroom should sit farthest from the door. Similarly, at the conclusion of class, students closest to the door should leave first.
7. While on campus, face coverings are required in all buildings and classrooms. Face coverings are also required in outdoor spaces where physical distance cannot be guaranteed. If a student does not have a face covering or refuses to wear an approved face covering without valid documented accommodation, the instructor will ask the student to leave the academic space and may report the student's actions to the Office of Community & Ethical Standards as a violation of the Student

Code of Conduct. If the student's actions disrupt the class to the extent that an immediate response is needed, the instructor may call the Clemson University Police Department at 656-2222.

8. Please note that the University may convert to a purely online mode at any time. University classes are initially in a purely online mode and will remain so until Sept. 21.
9. You are responsible for all assigned readings and information presented in class and on class Canvas site, including important announcements, due dates, assignments, exams and so forth.
10. Cheating of any kind is extremely serious and may result in a course grade of F and/or expulsion from the University.
11. Discussion is ok, but plagiarism is not. You can discuss homework, labs or projects with your colleagues but the solutions you turn in must clearly be your own.
12. Collaboration on exams is NOT ok!
13. No "Incomplete" grades will be given for the class, except under verifiable extraordinary circumstances.
14. Any student who disagrees with the grading of a homework assignment, project, or exam must contest the grading within one week of the date on which the graded material is returned to the class. This must be done by returning the original graded material to the instructor accompanied by a written description of the student's disagreement that is sufficiently detailed to allow accurate consideration of the claim.
15. You are not permitted to submit extra work in an attempt to raise your grade.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

TITLE IX STATEMENT: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- a. Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>)
- b. Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
- c. Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the [Undergraduate Announcements](#) and in the [Graduate School Policy Handbook](#).

COPYRIGHT STATEMENT: Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: <https://clemson.libguides.com/copyright>.

MODIFICATION STATEMENT: The instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations. The date of this version of the syllabus is August 11, 2020.