



MECE 6397 | Selected Topics

Section: 21585 | Synchronous Online

Instructor Information

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Office Hours

Tuesday/Thursday, 2:00-3:00 PM, or by appointment via email

General Course Information

Course Delivery:

This course is taught in three sections: one with face-to-face (FtF) lectures in class and the others with online synchronous lectures via Zoom/Teams (meeting link will be provided in Canvas)

Course/Class Numbers:

MECE 6397-16 (21584): Lecture (Face-to-Face)

MECE 6397-17 (21585): Lecture (Synchronous Online)

MECE 6397-18 (21586): Lecture (Synchronous - On Campus Exams)

Class Times and Classroom:

Tu/Th 10:00AM - 11:30AM for all the sections:

(1) Face-to-face lectures in Room D3 E218 (computer teaching lab, Engineering Building 2)

(2) Synchronous online lectures via online meeting platform (for MECE6365-02 and MECE6365-03); lecture recording to be posted in Canvas (Canvas → Courses → Modules)

Course Objectives and Student Learning Outcomes

Objective:

This course provides an introduction to semiconductor device fabrication technology, integrated circuit manufacturing, and computer-aided modeling for semiconductor process and device performance evaluation. The course examines the relationship between semiconductor materials, fabrication processes, device structures, and electrical characteristics, with an emphasis on silicon VLSI technology and modern CMOS devices.

Topics include semiconductor fundamentals, carrier transport, PN junctions, MOS capacitors, MOSFETs, CMOS technology, device scaling, short-channel effects, leakage mechanisms, and power-performance trade-offs. Students will study major semiconductor fabrication processes, including oxidation, diffusion, ion implantation, lithography, etching, deposition, isolation, planarization, metallization, and multilevel interconnect formation. Emphasis is placed on understanding how process conditions, materials, geometries, and process integration affect device structures and performance.

The course integrates analytical concepts with SILVACO Victory TCAD simulations to provide hands-on experience in semiconductor process and device modeling. Students will use SILVACO Victory Process to simulate and analyze semiconductor fabrication processes, examine evolving device structures, evaluate process parameters and material properties, and investigate fabrication challenges such as trench corner effects, oxide growth, and void formation degradation. Students will also use SILVACO Victory Device to simulate and evaluate semiconductor device characteristics and investigate the

relationship between fabrication processes, device structures, and device performance. Homework assignments emphasize simulation-based analysis, interpretation of process results, comparison of alternative fabrication approaches, and evaluation of process–device trade-offs in modern VLSI technology.

Expected Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain fundamental semiconductor device physics and the operation of PN junctions, MOSFETs, and CMOS devices.
2. Analyze semiconductor device characteristics using physical principles and analytical models.
3. Describe major semiconductor fabrication processes and their impact on device performance.
4. Explain CMOS scaling, short-channel effects, leakage, power consumption, and performance trade-offs.
5. Use SILVACO ATHENA to simulate semiconductor fabrication processes and analyze device structures.
6. Use SILVACO ATLAS to simulate and analyze semiconductor device characteristics.
7. Investigate the effects of process and device parameters on device performance using TCAD simulations.
8. Compare analytical models with numerical TCAD results and interpret simulation results.
9. Develop practical skills in semiconductor process and device modeling.
10. Communicate technical results effectively through written reports and engineering analysis.
11. Apply semiconductor physics, fabrication, and TCAD concepts to contemporary VLSI challenges.

Required Instructional Materials

Required Reading:

- Course materials in ppt format posted in Canvas (Course materials in Module)

Recommended Textbook (NOT required to purchase):

- Silicon VLSI Technology Fundamentals, Practice and Modeling by J.D. Plummer, M. D Deal, and P. B. Griffin

Complementary books:

- "Atlas of IC Technologies: An Introduction to VLSI Processes", W. Maly; "VLSI Fabrication Principles"; S. K. Ghandi, "VLSI Technology", S. M. Sze; "Solid State Electronic Devices" B. G. Streetman, "ULSI Technology", C.Y. Chang and S.M.Sze, S.. Cambel, "Microfabrication Engineering at the Micro- and Nanoscale (Oxford Series in Electrical and Computer Engineering), 4th edition

Course Schedule, Assignments, and Assessments

Course Schedule:

The course schedule, including assignment due dates and exam dates, is available in the Course Syllabus (Canvas → Courses → Syllabus).

TCAD Lab Assignments (30%): 2 combined homework assignments

- Each HW assignment should be submitted electronically via Canvas (HW assignments in Assignments).
- All the homework assignments must be submitted by 11:59 pm on the due date (Central Time Zone).
- For the homework assignment due dates, refer to “Course Syllabus”. In case of late submission within a day after the due date, 50% credit will be given. For late submission after a day after the due date, 0% credit will be given. Technology failures will not be accepted as a reason for late homework submissions – do not wait until the last minute to submit your homework.

Research Paper and Presentation (20%): A research paper and an in-class presentation on a selected topic will be required at the end of the semester. The project may be completed individually or in small groups of up to two students.

Grading Policy:

Midterm Exam 25%

Final Exam 25%

Homework assignments (2) 30% (15% each)

Research Presentation 20%

Syllabus Changes:

Please note that the instructor may need to make modifications to the course syllabus and may do so at any time. Notice of such changes will be announced as quickly as possible through the Canvas announcement.

Discussion and Lecture Topics

Course Topics

- Introduction and Historical Perspective
- Modern CMOS Technology
- Silicon & Crystal Physics: Crystal Growth Fabrication and Basic Properties of Silicon Wafers
- Front-End Processing & Doping: Thermal Oxidation and Si/SiO₂ Interface, Dopant Diffusion, Ion Implantation
- Manufacturing & Contamination: Silicon Manufacturing – Clean Rooms, Wafer Cleaning, and Gettering
- Patterning & Deposition: Lithography, Thin Film Deposition, Etching
- Integration: Back-End Technology

Grading Rubrics and Weights

Grading Rubrics:

Criteria	Percentages
Homework assignments (2)	30% (15% each)
Midterm Exam	25%
Research Paper and Presentation	20%
Final Exam	25%

TCAD Lab Assignments (30%): 2 combined homework assignments

- Simulation-based analysis, interpretation of process results, comparison of alternative fabrication approaches, and evaluation of process trade-offs in modern VLSI technology
- SILVACO simulation software is available on UH virtual lab with remote access
- Each HW assignment should be submitted electronically via Canvas (HW assignments in Assignments) by the due date
- All the homework assignments must be submitted by 11:59 pm on the due date (Central Time Zone)
- For the homework assignment due dates, refer to “Course Syllabus”. In case of late submission within a day after the due date, 50% credit will be given. For late submission after a day after the due date, 0% credit will be given. Technology failures will not be accepted as a reason for late homework submissions – do not wait until the last minute to submit your homework

Research Project (20%):

A research paper and an in-class presentation on a selected topic will be required at the end of the semester. The project may be completed individually or in small groups of up to two students. The project should focus on a specific technology, device, process, or emerging topic related to VLSI and should primarily consist of a literature review and critical analysis of relevant research publications.

No simulation or experimental work is required. Students are expected to review recent and relevant technical literature, explain the underlying technology, discuss its development and applications, compare approaches reported in the literature, and identify current challenges and future directions.

Course Policies and Procedures

Exceptions for Alternative Exam:

Students who are traveling or out of town for work, a conference, or an interview at the time of a scheduled exam are allowed to take an alternative exam. In such cases, the student must contact the instructor as soon as possible (no later than one week ahead of the exam date) for permission to take the online exam with the proper evidence for justification, such as travel documents, conference registration, interview invitation, etc.

The alternative exam will be arranged earlier than the regular exam. A later exam than the regular one will NOT be offered.

Absence from Exam:

No excuse will be accepted for the absence of an exam without proper evidence/ documents, e.g., doctor or hospital note, etc. For a student who submits “verifiable” documentation, the missed mid-term exam can be substituted with an increased weightage (considering the student's grade with respect to the class average grade) of the other mid-term exam. However, there will be no substitute for the final exam (Exam 3). If a student does not take the final exam, the student will not receive any credit for the final exam, unless the student contacts the instructor to pursue the make-up of the final exam within 2 days from the date of the final exam.

Policy for Make-Up of Final Exam:

Final exam is mandatory. If an emergency arises and Final Exam is missed, then, on a case by-case basis, there will either be a make-up test or an Incomplete (“I”) grade will be assigned. The make-up test will be given in the oral exam. The “I” grade could mean that Exam 3 will need to be taken with the final test in the subsequent semester unless other special arrangements are made with the instructor.

University Policies and Student Support Resources

Mental Health and Wellness Resources

The University of Houston has a number of resources to support students' mental health and overall wellness, including [CoogsCARE](#) and the [UH Go App](#). [UH Counseling and Psychological Services \(CAPS\)](#) offers 24/7 mental health support for all students, addressing various concerns like stress, college adjustment and sadness. CAPS provides individual and couples counseling, group therapy, workshops and connections to other support services on and off- campus. For assistance visit uh.edu/caps, call 713-743-5454, or visit a [Let's Talk](#) location in-person or virtually. Let's Talk are daily, informal confidential consultations with CAPS therapists where no appointment or paperwork is needed.

Need Support Now? If you or someone you know is struggling or in crisis, help is available. Call CAPS crisis support 24/7 at 713-743-5454, or the National Suicide and Crisis Lifeline: call or text 988, or chat 988lifeline.org.

Title IX/Sexual Misconduct

Per the UHS Sexual Misconduct Policy, your instructor is a “responsible employee” for reporting purposes under Title IX regulations and state law and must report incidents of sexual misconduct (sexual harassment, non-consensual sexual contact, sexual assault, sexual exploitation, sexual intimidation, intimate partner violence, or stalking) about which they become aware to the Title IX office (known at UH as the Equal Opportunity Services office or "EOS"). Please know there are places on campus where you can make a report in confidence. You can find more information about resources on the UH [Title IX/Sexual Misconduct Resources page](#). Please note that you may also report concerns of discrimination based on your protected class identity to EOS.

Reasonable Academic Adjustments/Auxiliary Aids

The University of Houston is committed to providing an academic environment and educational programs that are accessible for its students. Any student with a disability who is experiencing barriers to learning, assessment or participation is encouraged to contact the Justin Dart, Jr. Student Accessibility Center (Dart Center) to learn more about

academic accommodations and support that may be available to them. Students seeking academic accommodations will need to register with the Dart Center as soon as possible to ensure timely implementation of approved accommodations. Please contact the Dart Center by visiting the website: <https://uh.edu/accessibility/> calling (713) 743-5400, or emailing jdcenter@Central.UH.EDU.

The [Student Health Center](#) offers a Psychiatry Clinic for enrolled UH students. Call 713-743-5149 during clinic hours, Monday through Friday 8 a.m. - 4:30 p.m. to schedule an appointment.

The [A.D. Bruce Religion Center](#) offers spiritual support and a variety of programs centered on well-being.

The [Center for Student Advocacy and Community \(CSAC\)](#) is where you can go if you need help but don't know where to start. CSAC is a "home away from home" and serves as a [resource hub](#) to help you get the resources needed to support academic and personal success. Through our [Cougar Cupboard](#), all students can get up to 30 lbs of FREE groceries a week. Additionally, we provide 1:1 appointments to get you connected to on- and off-campus resources related to essential needs, safety and advocacy, and more. The [Cougar Closet](#) is a registered student organization advised by our office and offers free clothes to students so that all Coogs can feel good in their fit. We also host a series of cultural and community-based events that foster social connection and helps the cougar community come closer together. Visit the CSAC homepage or follow us on Instagram: @uh_CSAC and @uhcupbrd. YOU belong here.

Cougar Parent and Family Engagement Office

This office, under the Dean of Students Office (<https://www.uh.edu/dos/>), coordinates resources for Pregnant and Parenting Students (<https://www.uh.edu/dos/parenting-students/>), Parents and Family members of UH students (<https://www.uh.edu/dos/parents/>), and Sexual Misconduct Support Services (<https://www.uh.edu/dos/sexual-misconduct-support-services/>). A description of available support and resources are provided on the respective web pages. The Cougar Parent and Family Engagement Office is located in Student Center South, room B12.

Academic Honesty Policy

High ethical standards are critical to the integrity of any institution, and bear directly on the ultimate value of conferred degrees. All UH community members are expected to contribute to an atmosphere of the highest possible ethical standards. Maintaining such an atmosphere requires that any instances of academic dishonesty be recognized and addressed. The [UH Academic Honesty Policy](#) is designed to handle those instances with fairness to all parties involved: the students, the instructors, and the University itself. All students and faculty of the University of Houston are responsible for being familiar with this policy.

Excused Absence Policy

Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston [Undergraduate Excused Absence Policy](#) and [Graduate Excused Absence Policy](#) for reasons including medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to [military service](#), [religious holy days](#), [pregnancy and related conditions](#), and [disability](#).

Recording of Class

Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the [Justin Dart, Jr. Student Accessibility Center](#). If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not

authorized to be shared with anyone without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.