

**EEC 146A – Integrated Circuits Fabrication
Fall Quarter 2021**

Instructor:

Dr. Erkin Şeker

Dept. of Electrical and Computer Engr.

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Virtual Office Hours: Tuesday 3:30pm-4:30pm (Use recurring Zoom link on Canvas)

Teaching Assistants:

Ahasan Ahamed (Lab TA)

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Virtual Office Hours: Monday 12:00pm-1:00pm

Zhixing Lin (Grader)

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Virtual Office Hours: Thursday 3:30pm-4:30pm

Lecture Times:

Tue. and Thu. 1:10pm-2:00pm

Location:

Olson Hall, Room 251

Lab Times*:

Tuesday 9:00-11:50am

Wednesday 1:10-4:00pm

Thursday 9:00-11:50am

Location:

Kemper Hall, Room 1224

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*These are the times for in-person sessions. See Lab/Simulation Timeline table at the end.

Catalog Description:

Integrated Circuits Fabrication: (4 units) Lecture 2 hours; Lab 3 hours.

Basic fabrication processes for metal oxide semiconductor (MOS) integrated circuits. Laboratory assignments covering oxidation, photolithography, impurity diffusion, metallization, wet chemical etching, and characterization work together in producing metal-gate PMOS test chips which will undergo parametric and functional testing.

Prerequisites:

EEC 140A

Technology Use:

The students will need to have access to computer with audio/video capabilities and internet access.

Textbook:

Required: *Introduction to Microelectronic Fabrication, 2nd Edition* by Richard C. Jaeger. Prentice Hall, McGraw Hill, 2002.

Suggested reading: *Silicon VLSI Technology – Fundamentals, Practice, Modeling* by James D. Plummer, Michael D. Deal, Peter B. Griffin. Prentice Hall, 2000.

Grading:

Homework: 5%

Weekly Labs: 40%

Midterm Exams: 25% (Better exam weighed at 15%)

Quiz (15%)

Final Exam: 15%

Homework Sets:

There will be 7-8 homework sets which will typically be assigned a week before they are due. Homework will not be graded in detail but a full or no score will be administered for each question. However, it is essential to do the homework to prepare for the midterm and final exams.

Laboratory/Simulation Assignments:

There will be a combination of three in-person lab sessions and four remote simulation-based assignments. Each class section will be divided into three groups for managing the assignments. An industry-level process and device simulation tool, Silvaco ATHENA/ATLAS, will be used for the simulation assignments. More information on the laboratory/simulation assignments will be provided in class.

Exams:

There will be two midterm exams, for which the better-scored exam will be weighed at 15%. Final exam is scheduled for 8:00am-10:00am Thursday December 9, 2021. Final exam will be comprehensive. Further information will be given in-class prior to each exam.

Quizzes:

Short quizzes will be administered via Canvas. There will be approximately 10 quizzes during the entire quarter and the lowest grade will be dropped. There will be no make-up quizzes or time extension for late starts.

Make-up Exams and Quizzes:

Make-up exams will not be given unless cases of extreme extenuating circumstances arise.

Regrading:

If you disagree with the grading on homework, exams, quiz, and lab reports with a good reason, please attach a note and return it to the instructor. The instructor will review the grading and reassign points as necessary. Note that upon regrading the score may go up or down. All regrading requests need to be filed within a week of receiving the graded item.

Attendance & Late Submission Policy: Assignment submissions (including homework, midterm, final exam, quiz, lab/simulation assignments) will be submitted electronically on Canvas. Assignments submitted after deadline up to 24 hours will have 20% deducted; between 24 hours and 48 will have an additional 20% deducted. Any submission later than 48 hours will not be accepted. The quizzes will not have a grace period and will need to be completed by their deadlines.

COVID-Related: Please follow all campus requirements (i.e., vaccination, daily symptom survey, face coverage indoors) for all students and instructor's safety. <https://campusready.ucdavis.edu/students-and-families>

Academic Integrity:

Cheating and plagiarism will absolutely not be tolerated. Professional integrity is an important aspect of all engineering disciplines and understanding the material in these courses is integral to becoming a proficient and productive engineer. As such, it is imperative that you spend the time and effort to fully understand the material and seek help when necessary. Please read the UC Davis "[Code of Academic Conduct](#)" at participate.ucdavis.edu .

Student Resources: <https://ebeler.faculty.ucdavis.edu/resources/faq-student-resources/>

Lecture Timeline

Week	Date	Lecture	Topic
0.5	9/23	1	Intro to cleanroom, rules & safety training
1	9/28	2	MOSFET layout, cross-section, intro to process flow
	9/30	3	Oxidation
2	10/5	4	Oxidation & wet chemical etch
	10/7	5	Dry etching, (an)isotropic etching
3	10/12	6	Photolithography, pattern transfer
	10/14	7	Advanced Photolithography
4	10/19	8	Diffusion
	10/21	9	Diffusion (cont.)
5	10/26	-	MIDTERM 1
	10/28	10	Sheet resistance, junction depth
6	11/2	11	Ion implantation, annealing
	11/4	12	Ion implantation, annealing (cont.)
7	11/9	13	Physical vapor deposition (PVD)
	11/11	14	Chemical vapor deposition (CVD)
8	11/16	15	Metallization and interconnects
	11/18	16	Characterization techniques
9	11/23	-	MIDTERM 2
	11/25	-	THANKSGIVING
10	11/30	17	Process monitoring, dicing, wire bonding, packaging
	12/2	18	Biological microsystems & nanotechnology

Laboratory/Simulation Timeline

Week	Date	Description	Group*	Location
0.5	9/23	Safety Lecture	1, 2, 3	Classroom
1	9/28 - 9/30	Gowning and cleanroom safety	1	CNM2
		Gowning and cleanroom safety	2	CNM2
		Gowning and cleanroom safety	3	CNM2
2	10/5 - 10/7	Lithography	1	CNM2
		Introduction to Silvaco tools	2	Simulation
		Introduction to Silvaco tools	3	Simulation
3	10/12 - 10/14	Introduction to Silvaco tools	1	Simulation
		Lithography	2	CNM2
		Oxidation, dry etch, wet etch	3	Simulation
4	10/19 - 10/21	Oxidation, dry etch, wet etch	1	Simulation
		Oxidation, dry etch, wet etch	2	Simulation
		Lithography	3	CNM2
5	10/26 - 10/28	MIDTERM 1 (NO LAB)	1, 2, 3	Classroom
6	11/2 - 11/4	Device characterization	1	CNM2
		Diffusion & ion implantation	2	Simulation
		Diffusion & ion implantation	3	Simulation
7	11/9 - 11/11	Diffusion and ion implantation	1	Simulation
		Device characterization	2	CNM2
		Deposition & device simulation	3	Simulation
8	11/16 - 11/18	Deposition & device simulation	1	Simulation
		Deposition & device simulation	2	Simulation
		Device characterization	3	CNM2
9	11/23 - 11/25	MIDTERM 2 (NO LAB)	1, 2, 3	Classroom
10	11/30 - 12/2	NO LAB	1, 2, 3	

* Group assignments will be posted on Canvas during Week 1.

Approximate Laboratory/Simulation Report Deadlines

Week	Section	In-person				Simulation	
		Lab Date	Lab Date	Assigned (12:01 AM)	Due by (11:59 PM)	Assigned (12:01 AM)	Due by (11:59 PM)
0.5	1, 2, 3		9/23	9/23	9/28		
1	1	Tuesday	9/28	No Assignment			
	2	Wednesday	9/29				
	3	Thursday	9/30				
2	1	Tuesday	10/5	10/2	10/11	10/2	10/8
	2	Wednesday	10/6	10/3	10/12		
	3	Thursday	10/7	10/4	10/13		
3	1	Tuesday	10/12	10/9	10/18	10/9	10/15
	2	Wednesday	10/13	10/10	10/19		
	3	Thursday	10/14	10/11	10/20		
4	1	Tuesday	10/19	10/16	10/25	10/16	10/22
	2	Wednesday	10/20	10/17	10/26		
	3	Thursday	10/21	10/18	10/27		
5	MIDTERM 1 (NO LAB)						
6	1	Tuesday	11/2	10/30	11/8	10/30	11/5
	2	Wednesday	11/3	10/31	11/9		
	3	Thursday	11/4	11/1	11/10		
7	1	Tuesday	11/9	11/6	11/15	11/6	11/12
	2	Wednesday	11/10	11/7	11/16		
	3	Thursday	11/11	11/8	11/17		
8	1	Tuesday	11/16	11/13	11/22	11/13	11/19
	2	Wednesday	11/17	11/14	11/23		
	3	Thursday	11/18	11/15	11/24		
9	MIDTERM 2 (NO LAB)						
10	NO LAB						