

ECE 477 - Syllabus
Microelectronic Fabrication Lab
Fall 2019
Instructors: Wen Li

TIME: Lecture: 3:00pm-3:50pm Mondays and Wednesdays
Laboratory: 11:30am-2:20pm Thursdays (ECE477 Section 001)
3:00pm-5:50pm Thursdays (ECE 477 section 002)

ROOM: Lecture: 121 Farrall Ag Eng Hall
ECE 477 Laboratory: 3235 Engineering Building

INSTRUCTORS: Wen Li
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OFFICE HRS: W. Li: 4:00pm-5:00pm Wednesday in 2308A Engineering Building, **or by appointment**

COURSE WEB SITE: The primary web site is via the D2L Course Management System. Please point your browser to the following URL: <https://d2l.msu.edu/> and log-in with your MSUNet ID and password.

COURSE DESCRIPTION: This course is designed for undergraduate students interested in learning microfabrication procedures and safety. Lectures will focus on device theory, simulation, and procedures, while the laboratory will provide safety training and hands on learning of the instruments and procedure. As part of this course various devices will be fabricated and tested such that experience will be gained with each of the instruments in the ECE – Cleanroom.

COURSE OBJECTIVES:

At the completion of this course, each student should be able to do the following:

1. Describe common safety concerns associated with chemicals used in microfabrication
2. Demonstrate proper operation of fabrication facilities including:
 - Wafer cleaning
 - Standard lithography process
 - Thermal oxidation
 - Physical Vapor Deposition (PVD): Sputtering, and thermal evaporation
 - Wet chemical etching (of SiO₂, Si₃N₄, and/or TiN)
 - Reactive Ion Etching (RIE)
 - Thermal oxidization of wafers
3. Fabricate silicon diodes, capacitors, resistors, and MOSFETs.
4. Measure the electrical transport properties of the devices made.

TEXT (Reserved at the Main Library):

1. Introduction to Microelectronic Fabrication, 2nd Ed. by Richard C. Jaeger, Volume V in the Modular Series on Solid State Devices, Prentice Hall, New Jersey, (2002).
2. Silicon VLSI Technology: Fundamentals, Practice, and Modeling, J.D. Plummer, M.D. Deal, P.B. Griffin, Prentice Hall, (2000).
3. Fundamentals of Microfabrication: The Science of Miniaturization, 3rd Ed. by M. J. Madou, CRC Press, Boca Raton, FL, (2012).
4. Microchip Manufacturing, S. Wolf, Lattice Press, Sunset Beach, CA, (2004).

GRADING:

Homework:	10%
Exam1:	20%
Exam2:	20%
Project Report and Presentation:.....	30%
Laboratory Preparation & Participation:	20%

Homework Policy:

There are 6-7 problem sets throughout the semester. Homework is due at the beginning of class and no late homework is graded. Each student must turn in individual work. There is no restriction on cooperation, discussions, use of other sources for the homework assignments. If a solution to a problem is found in the literature, correct citations to the literature must be provided. All homework scores will be included in the course grade.

Lab Policy:

You are expected to make the scheduled lab times. The instructor will be there at the start of the lab time to let you into the lab. Makeup times can be difficult to schedule, but if necessary then work out a convenient time with the instructor to makeup the lab.

Exam Policy:

Two 50-minute Midterm Exams are held in the classroom during the regularly scheduled class time. Calculator is permitted in the exams unless it has features described on the “Prohibited” list below.

Prohibited:

- Pocket organizers
- Handheld pocket organizers
- Handheld or laptop computers
- Electronic writing pads or pen-input devices
- Calculator built into cell phones or other electronic communication devices
- Calculators with a typewriter keyboard (key in QWERTY format)

Project Report & Presentation:

Students will prepare a report and a group presentation for the results of the fabricated device along with measured data of selected devices and a comparison to theoretical prediction.

The final exam period will be used for project presentations.

Approximate Timeline:

	Day	Date	Topics Covered	Labs
1	W	August 28	Introduction – History and Market, Gown Sizing	
2	M	September 2	Labor day (no class)	Lab #1 Safety & 4 point probe
	W	September 4	Chemicals, Safety	
3	M	September 9	Semiconductor Physics	Lab #2 Clean & Thermal Oxide
	W	September 11	Semiconductor Physics	
4	M	September 16	Lithographic Process – wafer cleaning	Lab #3 Lithography-Mask1
	W	September 18	Lithographic Process – oxidation	
5	M	September 23	Lithographic Process – patterning, etching	Lab #4 Diffusion Doping
	W	September 25	Lithographic Process – etching	
6	M	September 30	Diffusion & Ion Implantation	Lab #5 Clean & Thermal Oxide
	W	October 2	Diffusion & Ion Implantation	
7	M	October 7	Exam 1	Lab #6 Pattern & Thin Oxide-Mask2
	W	October 9	Physical Vapor Deposition	

	Day	Date	Topics Covered	Labs
8	M	October 14	Physical Vapor Deposition	Lab #7 Pattern for vias-Mask3
	W	October 16	Chemical Vapor Deposition	
9	M	October 21	No class (conference travel)	No Lab
	W	October 23	Chemical Vapor Deposition	
10	M	October 28	Interconnects and Contacts	Lab #8 PVD of Metals
	W	October 30	Device Characterization	
11	M	November 4	Device Characterization	Lab #9 Pattern Metals-Mask4
	W	November 6	Surface Micromachining – laser	
12	M	November 11	Exam 2	Lab #10 Device Testing
	W	November 13	Surface Micromachining – laser	
13	M	November 18	Packaging & Yield	Lab #11 Device Testing
	W	November 20	Packaging & Yield	
14	M	November 25	MOS Process Integration	
	W	November 28	Thanksgiving	
15	M	December 2	MEMS	