

# Course Syllabus

## Semiconductor Device Fabrication Laboratory

EEE 5354L Section 0001

**Class Periods:** Lectures on Mondays, Period 7-8 (1:55 PM – 3:50 PM); Labs on other days

**Lecture Location:** NANO 115; **Lab Location:** NRF Teaching Lab

**Academic Term:** Spring 2024

-

### **Instructor:**

Yong-Kyu 'YK' Yoon

[ykyoon@ece.ufl.edu](mailto:ykyoon@ece.ufl.edu)

(352) 392-985

Office: 225 Larsen Hall

Office Hours: Tuesdays and Wednesdays 1:00 pm - 2:00 pm Zoom meeting:  
[ufl.zoom.us/j/3523925985](https://ufl.zoom.us/j/3523925985)

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

Please contact through the Canvas website

- Shreya Sahai, [Shreya.sahai@ufl.edu](mailto:Shreya.sahai@ufl.edu), Benton 200, office hours: TBA
- James Overmeyer, [jovermeyer@ufl.edu](mailto:jovermeyer@ufl.edu), Benton 200, office hours: TBA
- Kenneth Fluker, [kennethfluker@ufl.edu](mailto:kennethfluker@ufl.edu), NRF 200, office hours: TBA
- Ladan Jiracek-Sapieha, [Igocman.jiraceks@ufl.edu](mailto:Igocman.jiraceks@ufl.edu), NRF 200, office hours: TBA

-

### **Course Description**

The overall goal is to provide students with hands-on experience in semiconductor material characterization and device-fabrication techniques. (3 credits)

### **Course Pre-Requisites / Co-Requisites**

**None**

## **Course Objectives**

This course enables students to gain hands-on experience with semiconductor-based processes, units, and corresponding equipment, such as photolithography, oxidation, thin film deposition, etching, and packaging; and also let students gain experience on the design, fabrication, and characterization of electronic devices, micro sensors and actuators.

## **Materials and Supply Fees**

N/A

## **Required Textbooks and Software**

- No required textbooks; lecture notes will be distributed
- Required software: Klayout
- Download link: <http://www.klayout.de/build.html> Links to an external site.

## **Recommended Materials**

- C. Jaeger, Introduction to Microelectronic Fabrication, 2nd ed., Prentice Hall, 2002. ISBN-13: 978-0201444940.
- Stephen A. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd ed., Oxford University Press, 2001. ISBN-13: 978-0195136050.
- Dieter K. Schroder, Semiconductor material and device characterization, Third Edition ed.: John Wiley & Sons, Inc., 2006.
- S. May and S.M. Sze, Fundamentals of semiconductor fabrication, Wiley, 2004

<b>Week</b>	<b>Monday</b>	<b>Lecture</b>	<b>Lab</b>	<b>Note</b>
<b>1</b>	<b>Jan. 8</b>	Syllabus/Lab Safety/Photolithography	No lab	Grouping/Lab tour

2	Jan. 15	No Lecture	Lab#1: Photolithography (Diode mask#1)	PR coating, exposure, develop
3	Jan. 22	Wet Etching	Lab#2: SiO <sub>2</sub> (BOE)	Wet etching, HF handling
4	Jan. 29	Doping, diffusion	Lab#3: Spin-on-glass (SOG)/Diffusion	Thermal treatment, strip off SOG
5	Feb. 5	Oxidation; PN diodes	Lab#4: Photolithography (Diode mask#2) + BOE	Modified process is applied
6	Feb. 12	Dry etching; CMOS Intro (optional)	Lab#5: Drive-in + Photolithography (Diode mask #3)	TAs continue Photolithography of Diode mask#3
7	Feb. 19	Deposition -PVD, CVD; Metallization; Klayout Intro	Lab#6: Descum + Remove Natural Oxide + Sputtering aluminum, Lift-off	Rapid Thermal Annealing (TRA) is applied
8	Feb. 27	MEMS Intro; MEMS micro actuator design	Mask layout design	
9	Mar. 4	PN diodes characterization	Lab#7: Diodes Characterization	Layout design HW Cleanroom Gown
10	Mar. 11	Spring Break (No class, No Lab)		
11	Mar. 18	MEMS surface micromachining	Lab#8: Photo (MEMS mask#1); sputter Ti/Ni; Liftoff	MEMS layout design due
12	Mar. 25	MEMS bulk micromachining; DRIE	Lab#9: Photo (MEMS mask#2); BOE	Si wafers w/oxide
13	Apr. 1	Actuator characterization	Lab#10: DRIE	

<b>14</b>	<b>Apr. 8</b>	Makeup	Lab#11: MEMS testing
<b>15</b>	<b>Apr. 15</b>	Project Presentation	No Lab
<b>15</b>	<b>Apr. 22</b>	Project Presentation (Makeup)	No Lab

***Attendance Policy, Class Expectations, and Make-Up Policy***

Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>Links to an external site.) and require appropriate documentation. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/Links to an external site.>

***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Attendance	100	10%
Pre-lab	100 each	10%
In-lab performance	100 each	20%
Lab report	100 each	30%
Lab final presentation	100	10%
Project	100	20%
Total		100%

- Pre-Lab Assignment and Lab Report Submission: The deadline for the individual pre-lab assignment submission is the beginning of each experiment, and the deadline for the group lab report submission is to be announced by your TA. Please work ahead to ensure that your pre-labs and all lab reports are finished on time.
- Pre-Lab Late Policy: Pre-Labs must be turned in on time. You can participate in the lab that week, but you will not get any credit for the pre-lab for that week.
- Lab Report Late Policy: -20% within 24 hours of deadline; No credit after 24 hours past due date

### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate CatalogLinks to an external site.](#)  
[Grades and Grading PoliciesLinks to an external site.](#)

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/Links to an external site.> It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/Links to an external site.> Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/Links to an external site.> Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/Links to an external site.>

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between

students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>)Links to an external site. specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWCOE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)

- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html> [Links to an external site.](#)

### ***Campus Resources:***

#### ***Health and Wellness***

#### ***U Matter, We Care:***

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu> [Links to an external site.](#), and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

### **Sexual Discrimination, Harassment, Assault, or Violence**



If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#)[Links to an external site.](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/Links to an external site.>

### *Academic Resources*

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtmlLinks to an external site.>

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.eduLinks to an external site.>

**Library Support**, <http://cms.uflib.ufl.edu/askLinks to an external site.> Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/Links to an external site.>

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/Links to an external site.>

**Student Complaints Campus**: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/Links to an external site.>; <https://care.dso.ufl.eduLinks to an external site.>

**On-Line Students Complaints:** <https://distance.ufl.edu/getting-help/>Links to an external site.; <https://distance.ufl.edu/state-authorization-status/#student-complaint>Links to an external site..