

EEE 5354L Semiconductor Device Fabrication Laboratory Spring 2019 Section: 262E

1. Catalog Description

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

2. Pre-requisites and Co-requisites: EEL 5405

3. Course Objectives:

This course enables students to gain hands-on experience on 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.

4. Contribution of course to meeting the professional component: N/A

5. Relationship of course to program outcomes: This will not count toward a minor in ECE.

6. Instructor: Dr. Yong-Kyu "YK" Yoon

- a. Office location: Larsen 225
- b. Office Hour: Tuesday and Wednesday 1-2pm or On request
- c. Telephone: 352-392-5985
- d. Email: ykyoon@ece.ufl.edu, ykyoon@gmail.com
- e. Website (E-Learning): <http://elearning.ufl.edu/>

7. Teaching Assistants:

Name	Tim Clingenpeel	Hae-In Kim	Paritosh Rustogi
Office	Benton 200	Benton 200	Benton 200
Telephone	704-280-5111		352-745-9664
Email	tclinge1@ufl.edu	kimhaein@ufl.edu	paritoshrustogi@ufl.edu
Office Hour	TBD	TBD	TBD

8. Meeting Time and location (weekly group lecture and lab sections):

Lectures in NRF 115 on Mondays, 2:00 - 3:50pm

Lab sections in NRF 124, 127, 128, day and time to be determined at the first lecture

9. Class/laboratory schedule: Each week on Monday there is a 1-hour to 2-hour (1.5-hour on average) lecture. Tuesday through Friday, there will be a 3-hour lab session (requiring a pre-lab

assignment and a post-lab report). There will be a final test at the end of the semester. A tour of the NRF cleanroom facility will be scheduled during the semester.

10. Textbook and Software required: None

11. Recommended Reading:

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

12. Course Outline (topics covered by week or by class period):

Week	Monday	Lecture	Lab	Ref/Notes
1	Jan. 7	Safety Lecture	Grouping	Oxidation prep
2	Jan. 14	Oxidation & Photolithography / Mask design	Lab 1: Oxidation and oxide thickness characterization	
3	Jan. 21	MLK Day/no lecture	Lab 2: PR coating, exposure, develop	Diode Mask 1
4	Jan. 28	Etching	Lab 3: SiO ₂ (BOE)	
5	Feb. 4	Doping	Lab 4: Spin-on-glass (SOG)	p-,n- type
6	Feb. 11	CMOS Intro	Lab 5: Photolithography 2	Diode Mask 2
7	Feb. 18	Metallization techniques	Lab 6: BOE; Photolithography 3	Diode Mask 3
8	Feb. 25	MEMS Intro and Process Flow	Lab 7: Sputtering/Liftoff	Finish diode fabrication
9	Mar. 4	Spring Break / no lecture	Spring Break / no lab	
10	Mar. 11	Characterization - Diodes, Contact resistance	Lab 8: Diodes, Resistors, and Capacitors Characterizations	Bimorph Designs Due Monday
11	Mar. 18	DRIE	Lab 9: PECVD SiO ₂ and MEMS Photolithography 1	TAs sputter Ni/Cr /lift off outside of lab
12	Mar. 25	Actuator Characterization	Lab 10: MEMS Photolithography 2/BOE	No Friday Lab (homecoming)
13	Apr. 1	Surface and Bulk Micromachining	Lab 11: DRIE and SEM	
14	Apr. 8	MEMS characterization	Lab 12: MEMS Characterization	
15	Apr. 15	No Lecture	Makeup	Thanksgiving
16	Apr. 22	Final Presentation	Makeup	

13. Attendance and Expectations: Cell phones and other electronic devices are to be silenced. No text messaging during class, lab, and exams.

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Dress Code: Protective eyewear and protective gloves will be available and must be worn at all times while in the laboratory. **Long pants and close-toed shoe must be worn in the laboratory (no sandals).** Those who do not follow the dress code will not be allowed in the laboratory. No food and drinks of any kind (including chewing gum) are allowed in the laboratory.

14. Grading: 10% Attendance

20% Pre-lab and quiz

20% In-lab performance

30% Lab report

20% Final presentation

100% Total

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 the due date

15. Grading Scale:

Numeric Cutoff	Letter Grade	Grade Points
90	A	4.00
87	A-	3.67
83	B+	3.33
80	B	3.00
77	B-	2.67
73	C+	2.33
70	C	2.00
67	C-	1.67
63	D+	1.33

60	D	1.00
57	D-	0.67
<57	E	0.00

“Undergraduate students, in order to graduate, must have an overall GPA and an upper division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. Graduate students, in order to graduate, must have an overall GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

16. Make-UP Exam Policy: If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed work. University attendance policies can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Otherwise, make-up exams will be considered only in extraordinary cases, and must be taken before the scheduled exam. The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

17. Honesty Policy: All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

“...failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.”

(<http://www.dso.ufl.edu/sccr/procedures/honorcode.php>)

18. Accommodation for Students with Disabilities: Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

19. UF Counseling Services: Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
- Career Resource Center, Reitz Union, 392-1601, career and job search services.

20. Software Use: All faculty, staff and student 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.