Production of Electronic Materials

EMA 4614

Class Periods: MWF, Period 4, 10:40-11:30 am

Location: TBD

Academic Term: Fall 2025

Instructor:
Dr. Jennifer Hite
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(352) 273-3714
Office Hours: TBD, Rhines 152

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
NA

Course Description
This is a 3-credit undergraduate/graduate class (4614/6616). The course provides an overview of production of materials for use in solid state electronic devices. This includes understanding key processing techniques like deposition, lithography, etching, implantation, annealing, and oxidation as well as the mechanisms behind these processes such as nucleation and growth kinetics, segregation, selection of materials, and diffusion. Key characterization techniques to evaluate the processes will also be covered.

Course Pre-Requisites / Co-Requisites
Be specific and indicate if equivalent courses or instructor permission is relevant. This must match the catalog for approved courses

Course Objectives
To provide students understanding of: Modern semiconductor chip fabrication processes including wafer manufacturing, wet and dry etching, film deposition, diffusion, and ion implantation. Design, fabrication, and operation of basic electronic devices such as MOSFETs, bipolar transistors, and computer memory. Characterization of electronic materials.

Materials and Supply Fees
None

Relation to Program Outcomes (ABET):

Outcome	**Coverage***
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Medium
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

***Required Textbooks and Software*:** None

Recommended Materials

- Main text:
  - *Fabrication Engineering at the Micro- and Nanoscale*, S. A. Campbell, fourth edition, Oxford University Press, 2012, ISBN-10: 0199861226.
  - Note: This text can rented digitally for the semester for $65 through RedShelf.
- Supplementary texts:
  - *Principles of Electronic Materials and Devices*, S. O. Kasap, third edition, McGraw-Hill, 2006, ISBN-10: 0072957913.
  - *Semiconductor Device Physics and Design*, U. K. Mishra and J. Singh, first edition, Springer, 2008, ISBN: 9781402064807
- Nanohub.org account – will be used for device simulations in the latter half of the semester

Required Computer

Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/

Course Schedule *(tentative)*

		Module	Lecture	
	Introduction	1	1	Intro/Syllabus
Materials/ Basics	Materials	2	2	Basic Electronic Materials
			3	Basic Semiconductors
			4	Wafers (asynchronous)
				HOLIDAY
			5	Equipment basics
Fabrication Processes	Thin Films	3	6	Evaporation
			7	Sputter
			8	CVD, LPCVD
			9	PECVD, ALD
			10	Oxidation
	Doping/ Controlling Films	4	11	Diffusion
			12	Ion Implant
			13	Ion Implant
			14	Annealing
			15	Review
			16	Exam 1
	Etching	5	17	Etching
			18	Etching

			19	Etching
	Lithography	6	20	Lithography
			21	Lithography
			22	Guest Lecture (Asynchronous)
			23	Fab (Asynchronous)
				HOLIDAY
			24	Lithography
	Metrology	7	25	Metrology
			26	Metrology
			27	Metrology
			28	Review
			29	Exam 2
Process Integration	Contacts & Separation	8	30	Isolation & planarization
			31	Contacts, metallization
	Logic Devices	9	32	PN junctions
			33	Logic Devices
			34	Logic Devices
	Memory Devices	10	35	Memory Devices
			36	Memory Devices
	Advanced Devices	11	37	Other Devices
			38	Non-Si devices
				HOLIDAY
				HOLIDAY
				HOLIDAY
			39	Review
			40	Exam 3

Important Dates *(tentative)*

29 Sept *Exam 1 (Period 4, Classroom)*
31 Oct *Exam 2 (Period 4, Classroom)*
3 Dec *Exam 3 (Period 4, Classroom)*

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework	variable	15%
In class quizzes	variable	5%
Exam 1		30%
Exam 2		25%
Exam 3		25%
		100%

Grading Policy

Percent	Grade	Grade Points
90.3 - 100	A	4.00
90.0 – 90.2	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00

80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Academic Policies & Resources
UF General Academic Policies and Resources (Honor Policy, DRC, Academic and Health Resources): https://go.ufl.edu/syllabuspolicies.

Homework: Homework will be given for each of the modules. The homework is to reinforce concepts and help prepare for exams. All unexcused missed homework will be accepted between 0-24 hours after the deadline for a maximum 50% credit.

Attendance: Other than in emergency situations and those covered under university policies, you must *notify the instructor of your scheduled absence for exams and discuss make-up options* ***at least one week prior*** to your absence; failure to do so may not allow you to make up for the missed exam.

Exams: Exams will be held in person during class.

In-person quizzes: To help encourage attendance and absorption of the material, there will be periodic, unannounced quizzes during class. The format will vary: iClicker, paper and pen, CANVAS. Please bring a pen/pencil and wi-fi enabled device with you to class.

Commitment to a Positive 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.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:
• Your academic advisor or Undergraduate Coordinator
• HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
• Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu