ECE541/ME541  Microelectronic Fabrication Techniques

(Department of Electrical and Computer Engineering & Department of Mechanical and Industrial Engineering, Spring 2017)

Course Information

(1) Title: ECE541/ME541 Microelectronic Fabrication Techniques (CRN 20209/22184 and 4 credits)
(2) Schedule: 4:00 pm–5:15 pm, Monday and Wednesday (January 9th – April 26th, 2017)
(3) Location: Lecture Center Building A 005 (LC A005).
(4) Instructor: Zheng Yang (Email: yangzhen@uic.edu; Phone: 312-996-8367; Office: ERF3017)
(5) Materials: Lecture slides & notes posted on course website.

Recommended Prerequisite ECE 347 and ECE 449

Course Website

http://www.ece.uic.edu/~zyang/Teaching/20162017SpringECE541/index.html

Office Hours

(1) Regular office hours: 8:30 am ~ 10:00 am, Monday and Wednesday (January 9th - April 26th, 2017).
(2) Additional office hours: Please send your requests via emails ahead to make appointments.

Reference Books


Grading The grading is based on three exams in class and one Final Exam. In the three in-class exams, the lowest-score exam is dropped, while the other two exams count 30% each for the course overall score. The final exam is mandatory and counts 40% for the course overall score. (i.e., 30%×2 + 40% = 100%) No MAKEUP EXAMS will be given! The tentative schedules of the exams are listed below.

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<thead>
<tr>
<th>Exam #1</th>
<th>TBD</th>
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<tr>
<td>Exam #2</td>
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<tr>
<td>Exam #3</td>
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<tr>
<td>Final Exam</td>
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Course Descriptions This is a graduate level class focusing on microelectronic fabrications. This course emphasizes more on practical skills than theoretical principles. The main topics of this
course cover fundamentals of semiconductor materials and devices, cleanroom basics, Si wafers, oxidation, photo-lithography, e-beam lithography, wet etching, dry etching, physical vapor deposition, chemical vapor deposition, atomic layer deposition, molecular-beam epitaxy, diffusion, ion implantation, interconnect, packaging, metrology, optical & electron microscopy, and microelectronic device characterizations; with particular effort on introducing and explaining standard Si MOSFET fabrication process.

Professional and Ethical Responsibility

- Attend all lectures. Take exams on scheduled dates. No make-up exams or alternate arrangements will be allowed unless for reasons beyond a student’s control (supporting documents required).
- Read announcements on course website and Blackboard, as well as emails from the instructor and teaching assistants regularly.
- Review lecture slides and notes posted.
- Policy on cheating and plagiarism: Dishonest actions by students will result in appropriate disciplinary action. Intentional use or attempt to use unauthorized assistance, materials, or information, in any quiz, examination, or assignment and plagiarism in literature review report may lead to penalties such as a failing grade. College of Engineering and University guidelines will be followed. Generally, the minimum penalty for cheating is an E in the course; the maximum penalty is expulsion from the university. Giving aid on exams to others is also considered as a form of cheating.

Regulations for Religious Holidays

Students who wish to observe their religious holidays shall notify the instructor by the tenth day of the semester of the date(s) when they will be absent unless the religious holiday is observed on or before the tenth day of the semester. In such cases, the students shall notify the instructor at least five days in advance of the date when he/she will be absent.

Policy on Incomplete (IN) Grades

The UIC policy is that Incomplete (IN) grades should be given ONLY when the student is making satisfactory progress. Please see the current Undergraduate Catalog for a precise statement. In this course, any student looking for an IN grade needs to have a C average at the time he/she requests for an IN. If the student is earning a D or below, then and IN grade will not be given, regardless of other circumstances. Note that satisfactory progress is a necessary but not sufficient condition for an IN. There must also be an extraordinary reason why the instructor should consider giving an IN.
Name________________________

UIC email_____________________

PhD or Master program (circle one)
Advisor_______________________

Research Area_________________

Recommended prerequisites (circle “Yes” or “No”)
Did you take ECE347 before? Yes No
Did you take ECE449 before? Yes No

Recommended background courses on semiconductors and semiconductor devices (circle “Yes” or “No”)
Did you take ECE346 before? Yes No
Did you take ECE440 before? Yes No
Did you take ECE448 before? Yes No
Did you take ECE540 before? Yes No
Did you take ECE542 before? Yes No

Background knowledge (circle “Yes” or “No”)
Any background knowledge on quantum mechanics Yes No
Any background knowledge on solid state physics Yes No
Any background knowledge on semiconductor physics Yes No
Any background knowledge on microelectronic devices Yes No

How familiar on microelectronic devices (multiple choices, mark “Y” in the appropriate places in the table)?

<table>
<thead>
<tr>
<th>Diode</th>
<th>Bipolar transistor</th>
<th>MOSFET</th>
<th>LED photodiode</th>
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</thead>
<tbody>
<tr>
<td>Hear about the name before</td>
<td></td>
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<tr>
<td>Know the working principles</td>
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<td>Familiar with the mechanisms and equations</td>
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<td>Hand on fabrication experience</td>
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Any experience about the following microelectronic fabrication techniques? (circle “Yes” or “No”)

Cleanroom experience Yes No Wafer cleaning Yes No
Photo-lithography Yes No E-beam lithography Yes No
Thin film growth Yes No Mask design Yes No
Electron microscopy Yes No Etching Yes No

Any specific interests or topics for this course (e.g. e-beam lithography, thin film growth, LED fabrication etc)?
ECE 541/ME 541
Microelectronic Fabrication Techniques

Lecture 00 Course Overview

Zheng Yang

(ERF 3017, email: yangzhen@uic.edu)
General Remarks

This is a graduate level class.

Prerequisites: ECE347 or ECE449 or by instructor’s consent.

Recommended knowledge background: at least one of the following four courses ECE346, 440, 448, & 540.

This class is directed at ‘advanced’ graduate students; the focus is much more on practical realization than on theoretical principles.

Input by students is always welcome!
Contents and Topics

- Cleanroom basics
- Wafer cleaning
- Oxidation
- Lithography
- Etching
- Film deposition
- MOSFET fabrication process

Reference Books


International Roadmap for the Semiconductor Industry (www.itrs.net)
Applications of Microelectronic Fabrications

- Microelectronics
- Opto-electronics
- Micro-/Nanoelectromechanical Systems (MEMS/NEMS)
- Microfluidic Systems
Semiconductor

- In later sessions we will talk about semiconductor properties and semiconductor production in detail.
- A semiconductor is an ‘almost’ insulating material, in which by contamination (doping) positive or negative charge carriers can be introduced.
Transistor

- The most important electronic device based on silicon is the transistor
- The word ‘Transistor’ derives from transmitter and resistor, a connector that can be switched from resistive to transmissive.
- A transistor is a 3 terminal device, which has an input, an output and a control connection
- Devices that can change their electronic properties are called ‘active’
- Memory chips use transistors to store information, Processors use transistors to perform computations.