ECE 4100 - Introduction to Microelectronic Fabrication  Winter 2022

IMPORTANT NOTICE

Lectures and laboratories in this course will initially be conducted via remote instruction but will return to in-person instruction the week of February 28th 2022. All students are required to be present for in-person instruction at that time. Furthermore, University policy requires all students to be fully vaccinated against COVID-19 in order to attend campus and participate in this course.

Course Objectives

This course introduces students to the various technologies used in the fabrication of integrated circuits (ICs). Emphasis is on silicon based devices. Topics include wafer preparation, oxidation, thin film deposition, diffusion and ion implantation, lithography, wet and dry etching, and metallization. The application of these topics to CMOS, Bipolar, and GaAs devices is discussed.

Course Content

The following topics will be covered:

- Introduction to Microelectronic Fabrication
- Silicon and GaAs Substrates
- Oxidation and Doping
- Pattern Transfer
- Thin Film Deposition
- Process Integration
- Introduction to Micromachining and MEMS.

Textbook


Learning Outcomes

1. Familiarity with semiconducting materials, atomic structure, and doping process.
2. Understand and apply lithographic and etching techniques.
3. Understand and apply thin film deposition technologies.
4. Familiarity with microelectronic device design and structure.
5. Familiarity with MEMS design and structure.

Expected Competency Levels

<table>
<thead>
<tr>
<th>Outcome</th>
<th>KB</th>
<th>PA</th>
<th>IN</th>
<th>DE</th>
<th>ET</th>
<th>IT</th>
<th>CS</th>
<th>PR</th>
<th>IE</th>
<th>EE</th>
<th>EP</th>
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CEAB Graduate Attributes Assessed

PA.2 – Develops and/or implements a strategy to analyze complex engineering problems.
IN.4 – Understands appropriate safe work procedures during experiments or laboratory exercises.
**Evaluation**

The final course grade will be determined from a student's performance in laboratories, assignments, and on examinations. Programmable calculators are not allowed in the mid-term and final examination. Students must receive a minimum of 50% on the final examination and must complete all the laboratories in order to be eligible to receive a passing grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>20</td>
<td>F, S</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>Term Test 1</td>
<td>20</td>
<td>F, S</td>
<td>1, 3</td>
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<tr>
<td>Term Test 2</td>
<td>25</td>
<td>F, S</td>
<td>1, 2, 3, 4</td>
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<tr>
<td>Final Examination</td>
<td>35</td>
<td>S</td>
<td>1, 2, 3, 4, 5</td>
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* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

**Academic Integrity**

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations on Academic Integrity, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

**Requirements/Regulations**

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a passing final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University’s General Academic Regulations, as well as Section 3 of the Faculty of Engineering Academic Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

**Retention of Student Work**

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University’s Intellectual Property Policy and the protection of privacy provisions of The Freedom of Information and Protection of Privacy Act (Manitoba). Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

**Important Dates**

- **Term Test**
  - Friday, March 4th, 2022 (in class)
  - Friday, April 1st, 2022 (in class)
- **Voluntary Withdrawal Deadline**
  - April 25th, 2022
- **Louis Riel Day**
  - February 21st, 2022
  - No classes or examinations
- **Spring Break**
  - February 22nd – 25th, 2022
  - No classes or examinations
- **Good Friday**
  - April 15th, 2022
  - No classes or examinations

**Accreditation Details**

**Accreditation Units**

- Mathematics: 0%
- Natural Science: 25%
- Complementary Studies: 0%
- Engineering Science: 50%
- Engineering Design: 25%

**Graduate Attributes**

- KB: A knowledge base for engineering
- PA: Problem analysis
- IN: Investigation
- DE: Design
- ET: Use of engineering tools
- IT: Individual and team work
- CS: Communication skills
- PR: Professionalism
- IE: Impact of engineering on society/environment
- EE: Ethics and equity
- EP: Economics and project management
- LL: Life-long learning

**Competency Levels**

1. Knowledge (Able to recall information)
2. Comprehension (Ability to rephrase information)
3. Application (Ability to apply knowledge in a new situation)
4. Analysis (Able to break problem into its components and establish relationships.)
5. Synthesis (Able to combine separate elements into a whole)
6. Evaluation (Able to judge the worth of something)
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Grading Scale

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<th>Letter</th>
<th>Mark</th>
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<td>A+</td>
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<tr>
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<td>70–79</td>
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<td>C+</td>
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<td>45–54</td>
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<tr>
<td>F</td>
<td>&lt; 45</td>
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Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.