

ENG PHYS 4Z03
Semiconductor Manufacturing Technology
Winter 2019
Course Outline

CALENDAR/COURSE DESCRIPTION

Detailed description of fabrication technologies used in the semiconductor industry; computer modeling of device fabrication; analysis of device performance.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): ENGPYS 3F03 or 3F04 or MATLS 3Q03; and registration in the Faculty of Engineering

Anti-requisite(s): none

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Rafael Kleiman
JHE A324
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ext. 26290

Office Hours: By appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Michael Cino
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Office Hours: By appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

The course website, including all course information will be hosted on Avenue to Learn:

<http://avenue.mcmaster.ca/>

All course-related submissions must be done through Avenue to Learn Dropboxes.

It is the students' responsibility to check regularly the course web page (Avenue to Learn) for updates and announcements.

Students are required to obtain and maintain McMaster and Avenue to Learn e-mail accounts for timely communications between the instructors and the students.

COURSE OBJECTIVES

The objective of this course is to give an introduction to the theory and technology of micro/nanofabrication. Two thirds of the course is lecture-based, where the theory of basic processing techniques from the formation of semiconductor wafer material to the finished device assembly will be discussed.

One third of the lectures will be based in a classroom PC cluster. The students learn to use state-of-the-art process simulators to virtually fabricate semiconductor chips and subsequently test their electronic properties.

At the end of the course, the students should have a good understanding of the various processing techniques used to fabricate semiconductor micro/nano-scale devices, to be able to simulate these processes using process simulators and to simulate their performance using device simulators.

MATERIALS AND FEES

Required Text: N/A

Recommended resources used during the course will be posted on Avenue to Learn.

Reference Texts:

- *Introduction to Microelectronic Fabrication: Volume 5 of Modular Series on Solid State Devices*, Richard C. Jaeger, second edition, Prentice Hall, 2001
- *Fundamentals of Microfabrication and Nanotechnology*, Marc J. Madou, third edition, CRC Press, 2011. Earlier editions are useful as well.

Calculator: N/A

Other Materials: None.

COURSE OVERVIEW

Wk	Dates	Thursday Topic	Friday Topic	Friday-1	Friday-2
1	January 4, 5	SILVACO Tutorial	Introduction to Semiconductor Technology	Lecture	Talk
2	January 11, 16	SILVACO Tutorial	Device Technologies	Lecture	Talk
3	January 18, 19	SILVACO Tutorial	Materials	Lecture	Talk
4	January 25, 26	SILVACO Tutorial	Lithography	Lecture	Talk
5	February 1, 2	SILVACO Tutorial	Thin film Deposition and Oxidation	Lecture	Talk
6	February 8, 9	SILVACO Tutorial	Thin film etching	Lecture	Talk
7	February 15, 16	SILVACO Tutorial	Doping: Ion Implantation/Diffusion	Lecture	Talk
8	February 22, 23	Study Break	Study Break	Study Break	Study Break
9	March 1, 2	SILVACO open lab	Process Flows	Lecture	Talk
10	March 8, 9	SILVACO open lab	Novel Fabrication Processes	Lecture	Talk
11	March 15, 16	Student Talks*	Student Presentations	Student Talks	Student Talks
12	March 22, 23	Student Talks*	Student Presentations	Student Talks	Student Talks
13	March 29, 30	Student Talks*	Good Friday	Good Friday	Good Friday
14	April 5, 6	Student Talks*	No Class	No Class	No Class

*The location of the Thursday oral presentations will be posted later. Scheduling of your presentation will be done via a Doodle poll.

Note: We have an educational licence for SILVACO which can be accessed through any computer cluster on campus. Submissions from other versions of SILVACO will not be accepted.

At certain points in the course it may make good sense to modify the schedule outlined above. The Instructor reserves the right to modify elements of the course and will notify students accordingly, both in class and on Avenue to Learn. Posted changes take precedence over this course outline.

The course includes one computer cluster-based lecture per week and one classroom-based lecture per week. The course includes the following components.

SILVACO Projects	SILVACO is a computer program that is used for process and device simulation. For the first 7 weeks there will be a computer cluster-based lecture to learn how to use the program. After proficiency is gained, a design project will be assigned, to be completed using SILVACO. Technical assistance from the course TA will be provided as needed until submission.
Student Projects	This is an opportunity for self-directed learning. Topics need to be chosen either from a suggested list (provided separately) by the Instructor, or any other topic approved by the Instructor. Students must choose distinct topics, by emailing the Instructor with their choice. Topic choices will be approved on a first-come, first-served basis. Please email the Instructor if you have a topic choice that is not listed.
Project Outline	Topics selection, an abstract, and at least 3 references from the scientific literature (that you will use in researching your topic) are to be provided. More detailed guidelines are provided separately.
Written Report	A written report on your topic, with an emphasis on device fabrication, according to the guidelines provided separately.
Oral Presentation	An oral presentation (20 minutes + 5 minutes for questions) on your topic according to the guidelines provided separately. Students in the audience are expected to ask questions and help in evaluating the presentations.

ASSESSMENT

Component	Weight	Due Date
Participation*	10%	January 4 – April 5, 2018
Student Project Outline	10%	Sunday, January 28, 2018, 11:59 pm
Student Project Written Report	30%	Sunday, March 4, 2018, 11:59 pm
Student Oral Presentation	20%	March 15 – April 5, 2018
SILVACO Project	30%	Sunday, April 8, 2018, 11:59 pm
Total	100%	

All submissions must be made via Avenue to Learn. Late submissions will not be accepted and a grade of 0 will be assigned. Please plan ahead to be able to submit your work on time. Early submissions are most welcome.

Attendance at lectures and participation in classroom discussions is expected. *The participation grade will be calculated based on participation in the classroom-based and computer-based sessions and student-delivered oral presentations.

All submissions are to be prepared and submitted *individually* and in accordance with the Academic Integrity Policy.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only, and will not be directly taken into consideration in determining a student's actual grade in the course.

Outcomes	Indicators
The students will learn the engineering processes involved in semiconductor manufacturing (Written Report)	1.4
The students will learn to apply appropriate mathematical techniques to model semiconductor fabrication processes (Written Report)	2.2
The students will learn to select the appropriate physical models for predicting the outcome of semiconductor processes and will learn to identify assumptions and constrains (Written Report)	3.2
The students will learn to recognize and follow an engineering design process to design a process flow for fabricating a semiconductor device (SILVACO Report)	4.1, 4.3
The students will learn to propose solutions to open-needed problems during their SILVACO project focused on designing a process flow for fabricating a semiconductor device (SILVACO Report)	
The students will learn to use state-of-the-art semiconductor processing software (SILVACO Report)	5.2
The students will demonstrate an ability to respond to technical and non-technical questions through implementing their design project and preparing their final reports (SILVACO Report)	7.1
The students will learn to present information clearly and concisely as appropriate to the audience (Oral Presentation)	7.2

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for [Academic Accommodation of Students with Disabilities](#).

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

1. The [McMaster Student Absence Form](#) is a self-reporting tool for Undergraduate Students to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note this tool cannot be used during any final examination period.
2. You may submit a maximum of 1 Academic Work Missed request per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation. Relief for missed academic work is not guaranteed.
3. If you are absent for reasons other than medical reasons, for more than 3 days, or exceed 1 request per term you MUST visit the Associate Dean's Office (JHE/A214). You may be required to provide supporting documentation.
4. This form must be submitted during the period of absence or the following day, and is only valid for academic work missed during this period of absence.
5. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.
6. You should expect to have academic commitments Monday through Friday but not on Saturday, Sunday or statutory holidays.
7. If you require an accommodation to meet a religious obligation or to celebrate an important religious holiday, you may submit the Academic Accommodation for Religious, Indigenous and Spiritual Observances (RISO) Form to the Associate Dean's Office. You can find all paperwork needed [here](#):

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

COURSE POLICIES

1. It is the students' responsibility to regularly check the course web page (Avenue to Learn) for updates and announcements.
2. Students are required to obtain and maintain a McMaster e-mail account for timely communications between the instructor and the students.
3. You are expected to behave in a way that does not disrupt the learning experience of your peers. Disruptive behavior including making noise, leaving and entering the classroom, and use of cellular phones is forbidden and students presenting this type of behavior will be asked to leave the classroom.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/>.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue to Learn. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <http://www.mcmaster.ca/policy/faculty/Research/ResearchIntegrityPolicy.pdf>