

ECE 4452 – Integrated Circuit Fabrication

Course Educational Objectives

(Brackets at the end of each statement identify the program's Student Outcome(s) to which that objective is contributing.)

As part of this course, students ...

1. learn the basic fabrication processes used to fabricate integrated circuits. [c]
2. attain hands-on experience in fabricated integrated circuits & devices and characterizing the resulting electronic circuit. [b, k]
3. engage in formal written communication exercises including laboratory reports and design projects. [g]
4. learn how to correlate non-ideal integrated circuit operation back to the fabrication process used to manufacture the device under test. [a, e]
5. learn how to model integrated circuits based on processing parameters. [a, e]
6. learn how to modify integrated circuit fabrication processes to improve device performance. [c, e]

Course Educational Outcomes

Upon successful completion of this course, students should be able to ...

1. fabricate CMOS circuitry using a basic CMOS manufacturing procedure.
2. perform common fabrication processes used in microelectronics fabrication.
3. test integrated circuits and interpret non-ideal behaviors.
4. correlate non-ideal IC behavior back to the processes used to fabricate the device under test.
5. model IC physical parameters such as junction depth, dopant concentration and modify fabrication process flow designs to improve device performance.
6. write technical reports related to the laboratory experiences, integrated circuit characterization, and a process design project.
7. compile a Process Design Project including analyzing non-ideal performance of fabricated ICs, developing a process flow to improve performance

ECE 4752 Microelectronics Processing Laboratory

Fall 2013

Time: Lecture Monday and Wednesday, 11:05-11:55 AM, VL456
Weekly laboratory session as assigned

Instructor: Professor Bruno Frazier
223 Pettit Building
Bruno.Frazier@ece.gatech.edu

Text: G. May & S. Sze, Fundamentals of Semiconductor Fabrication, ISBN: 0-471-23279-3
Reference: R. Jaeger, Introduction to Microelectronic Fabrication, 2nd edition, ISBN: 0-201-44494-7

Pre-requisites: (ECE3030 or ECE3040) and ECE2031

Laboratory Instructor: Dr. Seung-Joon Paik, 114 Pettit Building, spaik8@gatech.edu

Teaching Assistant: Troy Messina
Tmessina3@gatech.edu

Office Hours: Frazier – Tuesday, 11:00 AM - 1:00 PM, or by appointment
Messina – MWF 12-1:30, or by appointment, MiRC Cubicle A-3

Grading:

Your grade will be based on homework (5%), exam 1 (20%), final exam (design project) (25%), laboratory reports with updated model (30%), laboratory notebook (10%), final exam (10%). The content of the laboratory notebook and laboratory reports is described in more detail per the additional handout.

The Examinations will be held per the attached schedule. A grade of zero will be given for any missed exam for which there have been no arrangements made beforehand, unless you have a written medical excuse.

The Process Design Project is due Wednesday, November 26th, 12:00 PM.

Laboratory Notebooks are due on the last day of classes before exam week.

Laboratory Reports are due at the beginning of your lab session on assigned weeks. The Characterization Lab Report is due on the last day of classes before exam week.

Class Rules and Regulations:

1. In the laboratory sessions, please note: safety is of the utmost concern in this class. Although all procedures in this laboratory are safe if done properly, improper procedures can result in severe injuries.
2. The laboratory reports and the computer modeling projects will be an individual effort (i.e., one laboratory report from each student). If you have any questions regarding when your fellow students can help you and when they can't, please ask the instructor.
3. Because we are on a tight schedule, and because independent work in the laboratory cannot be allowed due to safety reasons, it is extremely important that you attend EVERY laboratory session. If either you cannot attend a session, please notify me and Ms. Rose as soon as possible. In these cases, the laboratory instructor can be 'hired' to process your wafers for you, at a 'cost' of a 20 exam points for the course per occurrence.

4752 — FALL 2013
MW 11:05AM – 11:55AM VL456

WEEK #	LECTURE TOPIC	LAB REPORTS DUE	LAB ACTIVITIES
1	Introduction, Safety Semiconductor Materials		None
2	Crystallography	Safety Quiz	Clean, Field Oxidation + Wafer Characterization
3	Oxidation		Mask #1 P-Well
4	Photolithography	Lab Report 1 Clean/Characterization/Oxid.	P-Well Pre-dep Drive-in / Oxidation
5	Diffusion		Mask #2 PMOS S/D
6	Ion Implantation	LR2 P-Well Pre-deposition	PMOS S/D Pre-dep Drive-in / Oxidation
7	Plasma Processing	LR3 P-Well Drive-in/Oxidation	Mask #3 NMOS S/D
8	PVD Processes	LR4 PMOS Source & Drain Pre/Drive-in/Oxidation	NMOS S/D Pre-dep, Drive-in
9	CVD Processes		No Labs
10	Exam #1		Mask #4 Oxide Etch for Gate / Contacts
11	Wet Etching		Gate Oxidation Mask #5 Contacts
12	MEMS Processes	LR5 NMOS S&D Pre/Drive-in/Gate Oxidation	Metallization Mask #6 Trace Definition
13	MEMS Processes		Sintering/Annealing
14	MEMS Processes	LR6 Contacts / Metallization	Device Characterization
15	Holiday Break		Device Characterization
16	Integration	LR7 Device Characterization	Device Characterization

Improved Process Design Project: Due December 10th 12:00 PM

ECE 4752 LABORATORY SCHEDULE (Fall 2013)

DATES OF LAB S	TOPICS	LOCATION
Aug. 19th, 27th - 30th 1:30pm – 4:30pm	Lab Session 1: Introduction to laboratory sessions Wafer inspection, cleaning and oxidation	MiRC Cleanroom
Sept. 3rd - 6th 1:30pm – 4:30pm	Lab Session 2: Photolithography (P-well) and oxide etch	MiRC Cleanroom
Sept. 9th – 13th 1:30pm – 4:30pm	Lab Session 3: P-well diffusion	MiRC Cleanroom
Sept. 16th – 20th 1:30pm – 4:30pm	Lab Session 4: Photolithography (P+) and oxide etch	MiRC Cleanroom
Sept. 23th – 27th 1:30pm – 4:30pm	Lab Session 5: P+ diffusion and oxidation	MiRC Cleanroom
Sept. 30th – Oct. 4th 1:30pm – 4:30pm	Lab Session 6: Photolithography (N+) and oxide etch	MiRC Cleanroom
Oct. 7th – 11th 1:30pm – 4:30pm	Lab Session 7: N+ diffusion	MiRC Cleanroom
Oct. 14th – 18th	No Lab session (Fall break week)	
Oct. 21th -25th 1:30pm – 4:30pm	Lab Session 8: Photolithography (gate) and oxide etch	MiRC Cleanroom
Oct. 28st – Nov. 1st 1:30pm – 4:30pm	Lab Session 9: Oxidation, photolithography (contact) and oxide etch	MiRC Cleanroom
Nov. 4th – Nov. 8th 1:30pm – 4:30pm	Lab Session 10: Metallization and Photolithography (metal)	MiRC Cleanroom
Nov. 11th – 15th 1:30pm – 4:30pm	Lab Session 11: Metal etch and annealing End of process	MiRC Cleanroom
Nov. 18th – 27th TBD	Lab Session 12: Characterization and measurements	MiRC Room 245