Boston University

EC 578 FABRICATION TECHNOLOGY OF INTEGRATED CIRCUITS

Prerequisite:	EC 410 or equivalent
Professor:	Kleptsyn
Class hours:	MW 4:30-6:15
Office hours:	W 10:00-12:00
Credits:	4
Maximum number of students	12

Books (recommended):
Sami Franssila. Introduction to Microfabrication, 2nd edition. 2010.
Also recommended:
Richard C. Jaeger. Introduction to Microelectronic Fabrication. 2002
James D. Plummer, Michael D. Deal, Peter B Griffin. Silicon VLSI Technology. 2000
S.K.Ghandhi. VLSI Fabrication principles 1996.

COURSE CONTENTS

1. Silicon. Material properties, p- and n-types of silicon, single crystals, crystal structures, unit cells, crystallographic planes, Miller indices. Defects and impurities in crystals.
2. Bands, band structure, doping, band gap levels.
3. Silicon wafers, wafer fabrication, wafer cleaning, surface preparation. Ion implantation. SOI wafers.
4. Silicon processing review (wafer level).
5. Oxidation, kinetics of oxidation, wet and dry oxidation, color chart. Thin film measurements, ellipsometry, FTIR, interference microscopy, ZYGO Microscope.
6. Photolithography and masks. Mask design and fabrication.
7. Photoresist processing, BOE etching, photoresist removal.
8. Phase diagrams, solid solubility. Diffusion, Fick's laws, diffusion from an unlimited and limited sources; interstitial and substitutional diffusion, diffusion coefficient, activation energy. Design of the diffusion process.
9. BJT design and fab. Field effect, MOSFETs. MOSFET design and fabrication steps.
10. Silicon wet etching and reactive ion etching. DRIE.
11. Metal deposition techniques. Contacts. Lift-off process.
12. Etching metallic and dielectric films. Etch rate control.
13. Miscellaneous and auxiliary techniques.
14. Measurement and characterization techniques

In the lab section students will use their theoretical background to process semiconductor devices (wafer level) and acquire the skills needed to do research on solid state devices.

PROJECT

In this course the practical aspects of the fabrication process are the main focus of attention. Basics and theoretical aspects including calculations of the physical processes and parameters will be given and considered accordingly.

The first and the main goal of this course is to guide students through the practical steps of making an integrated circuit of their own design. As a rule, those steps including measurements and inspection will be supposed to perform manually for more profound understanding of the physical and chemical processes.

The project consists of three main portions:

1. Design. Students will have to design a circuit (e.g. amplifier), transistors, masks and technological process of the fabrication on the wafer level.
2. Processing. Students will perform all necessary technological steps starting with plain wafer; the wafer containing a few hundred patterned chips should be presented at the end of the course.
3. Inspections and tests will have to be done after each technological step/operation. Final wafer inspection may include measurements and characterization.

Grading: Homework 25%, Labwork (project) 35%, Final exam 40%.

Academic Misconduct

BU takes academic integrity very seriously. Academic misconduct is conduct by which a student misrepresents his or her academic accomplishments, or impedes other students' opportunities of being judged fairly for their academic work. Knowingly allowing others to represent your work as their own is as serious an offense as submitting another's work as your own. More information on BU's Academic Conduct Code, with examples, may be found at http://www.bu.edu/academics/policies/academic-conduct-code .

Collaboration Policy

In this class you may use any textbooks or web sources when completing your homework, and/or one human collaborator (from class) per homework, subject to the following strictly enforced conditions:

You must clearly acknowledge all your sources (including your collaborators) on the top of your homework.

You must write all answers in your own words (although Java code may be shared with your collaborator)

You must be able to fully explain your answers upon demand (and I will demand it!).

You may not use any human resource outside of class (including web-based help services, outside tutors, etc.) in doing your homeworks or project. Obviously, you may not collaborate with anyone on exams.

Failure to meet any of the above conditions could constitute plagiarism and will be considered cheating in this class. If you are not sure whether something is permitted by the course policy, ASK ME! (it's much more awkward to explain your actions after the fact to the college disciplinary committee).