ENGR 61A: INTRODUCTION TO SEMICONDUCTOR TECHNOLOGY

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Winter 2024
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Upon completion of the course, students will be able to list safety concerns and precautions and contamination concerns and precautions.
- Upon completion of the course, students will be able to describe stages of the semiconductor manufacturing process.
- Upon completion of the course, students will be able to describe the principles of troubleshooting.

Description

This course provides an overview of the semiconductor industry. Focus on clean room safety, wafer processing, and troubleshooting. Students practice scientific thinking and have exposure to running experiments.

Course Objectives

The student will be able to:

1. Importance of semiconductor manufacturing
    a. Identify types of devices
    b. Explain Moore's law
    c. Understand silicon as a material
    d. Discuss the current state of semiconductor manufacturing technology
2. Scale
    a. Understand distance scale key concepts
    b. Understand time and frequency scales of micro/nanoelectronics
    c. Discuss the temperature and energy scales of micro/nanoelectronics
    d. Explain issues related to scale
3. Safety
    a. Demonstrate proper safety equipment usage and procedures
    b. Understand proper emergency procedures
4. Phone breakdown
    a. Understand phone components
5. Brief overview of semiconductors
    a. Understand the importance of semiconductors and industry innovations
6. Wafer handling
    a. Demonstrate different wafer handing methods
    b. Understand contamination and how to prevent it
7. Semiconductor fabrication
    a. Describe clean room overview
    b. Explain crystal growth and epitaxy
    c. Describe doping: Diffusion, implantation, and annealing
    d. Understand oxidation and film deposition
    e. Describe etching and polishing
    f. Describe photolithography
    g. Discuss metallization and interconnects
    h. Understand issues in building transistors
    i. Describe IC packaging
    j. Understand reliability
8. Measurements and troubleshooting
    a. Identify measurement tools for different properties and how to use them
    b. Design and interpret testing processes
    c. Troubleshoot issues

Course Content

1. Importance of semiconductor manufacturing
    a. Types of devices
    b. Moore's law
    c. Silicon as a material
    d. Current state of the art
2. Scale
    a. Scale in the universe
    b. The micro/nanoelectronics distance scale
    c. The time and frequency scales of micro/nanoelectronics
    d. The temperature and energy scales of micro/nanoelectronics
    e. Issues related to scale
3. Safety
    a. Protection equipment
    b. Procedures
    c. Issues and how to respond
    d. Keeping yourself safe
        i. Stay alert
        ii. PPE
        iii. Follow directions carefully
        iv. Disposing of hazardous materials
    e. Keeping others safe
        i. Leaving tools in proper state
        ii. Reporting when things are not working
        iii. Disposing of hazardous materials
    f. Emergency protocols
        i. Chemical issues – gas
        ii. Chemical issues – liquid
        iii. Mechanical issues
        iv. Power outages
4. Phone breakdown

a. Components
b. Functions
c. Issues in manufacturing

5. Brief overview of semiconductors
   a. Material properties
   b. How materials can be used
   c. History of issues with semiconductor processing and how the industry has overcome them
6. Wafer handling
   a. Wafer characteristics
      i. Dimensions of different wafers
      ii. Wafer breakage
   b. Wafer carriers
   c. Moving wafers
      i. Using tweezers
      ii. Vacuum wands
   d. Cutting wafers
   e. Attaching coupons to wafers
   f. What contamination is
   g. Types of contamination
      i. Biological
      ii. Chemical
      iii. Metal
   h. How it happens
   i. How to prevent contamination
7. Semiconductor fabrication
   a. The clean room
   b. Crystal growth and epitaxy
   c. Doping: Diffusion, implantation, and annealing
   d. Oxidation and film deposition
   e. Etching and polishing
   f. Photolithography
   g. Metallization and interconnects
   h. Building transistors
   i. IC packaging: Wirebonds, cans, DIPs, and flip-chips
   j. Reliability
8. Measurements and troubleshooting
   a. Measurement tools
   b. How to operate them
   c. Running and interpreting tests
      i. Test purpose
      ii. Experiment design
      iii. Measurements and interpretation
      iv. Troubleshooting experiment next steps
   d. What is troubleshooting
   e. Practice isolating issues
   f. Connecting multiple issues

Lab Content

Not applicable.

Special Facilities and/or Equipment

None.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Written work
Projects
Presentations

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture and hands-on experience
Small and large group discussions
Projects
Presentations

Representative Text(s) and Other Materials

Cressler. Silicon Earth. 2009.

This is the most recent edition of this text; when a new edition is published we will adopt it. This text includes all of the relevant information even though it was written more than 5 years ago. This text presents this information in an approachable manner for an introductory course.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

Additional reading assignments, projects, and presentations.

Discipline(s)

Engineering