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:	Area III: Natural Sciences
Transferable:	CSU
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

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:

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

Course Content

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

    i. Wafer characteristics
        1. Dimensions of different wafers
        2. Wafer breakage
    ii. Wafer carriers
    iii. Moving wafers
        1. Using tweezers
        2. Vacuum wands
    iv. Cutting wafers
    v. Attaching coupons to wafers
    vi. What contamination is
    vii. Types of contamination
        1. Biological
        2. Chemical
        3. Metal
    viii. How it happens
    ix. How to prevent contamination
g. Semiconductor fabrication
    i. The clean room
    ii. Crystal growth and epitaxy
    iii. Doping: Diffusion, implantation, and annealing
    iv. Oxidation and film deposition
    v. Etching and polishing
    vi. Photolithography
    vii. Metallization and interconnects
    viii. Building transistors
    ix. IC packaging: Wirebonds, cans, DIPs, and flip-chips
    x. Reliability
h. Measurements and troubleshooting
    i. Measurement tools
    ii. How to operate them
    iii. Running and interpreting tests
        1. Test purpose
        2. Experiment design
        3. Measurements and interpretation
        4. Troubleshooting experiment next steps
    iv. What is troubleshooting
    v. Practice isolating issues
    vi. 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