Miami Dade College

Course Description

ETS2160C | Introduction to Semiconductors and Vacuum Science | 3.00 credits

This course offers a foundation in semiconductor fabrication, material properties, and vacuum technology. Students explore device miniaturization, learn about key materials used in semiconductor manufacturing, and operate vacuum systems to understand their role in defect-free manufacturing.

Course Competencies

Competency 1: The student will be able to demonstrate an understanding of wafer fabrication, miniaturization, and key semiconductor applications by:

1. Having a fundamental understanding for the overall process flow of fabricating a microelectronic device
2. Understanding the different types of applications of semiconductor products including devices such as transistors, MOSFETS, diodes, and solar cells
3. Developing a working knowledge for transistor functionality and the importance of Moore's law in miniaturization

Competency 2: The student will be able to define key material types in semiconductor manufacturing and device processing by:

1. Describing key properties of semiconductors including conductivity range, temperature response, and crystal structure
2. Describing key properties of dielectric materials including insulation, charge storage, and polarization
3. Identifying key properties of metals including electrical conductivity, bonding, and oxidation

Competency 3: The student will be able to define key semiconductor materials and their properties by:

1. Identifying the unique properties of silicon that have historically made it the preferred material for semiconductors
2. Understanding direct versus indirect bandgap semiconductors by comparing direct bandgap materials such as GaAs to indirect bandgap materials such as silicon
3. Describing the technological significance of wide band gap semiconductors, such as silicon carbide and gallium nitride, which can operate at higher voltages, frequencies, and temperatures

Competency 4: The student will have a strong foundation of vacuum science and fundamentals of vacuum technology as applied in semiconductor manufacturing by:

1. Defining a vacuum environment and understanding key characteristics of vacuum
2. Differentiating the different levels of vacuum used in the semiconductor industry, including low-vacuum, high-vacuum, and ultra-high vacuum
3. Identifying the different hardware used in vacuum science including vacuum pumps, vacuum gauges, valves, and fittings
4. Defining the mean free path in a vacuum environment and its importance as it pertains to defect free manufacturing

Competency 5: The student will be able to operate and maintain a vacuum system through hands-on applications by:

1. Demonstrating proper technique for the assembly of vacuum system components
2. Conducting leak checks using appropriate diagnostic tools and methods
3. Explaining and applying vacuum science fundamental principles, including the relationship between pressure, gas flow, and system performance for various applications
4. Following the proper order of operations for vacuum system startup, operation, and shutdown
5. Using the vacuum trainer system to understand other important concepts in semiconductor manufacturing such as plasmas and vapor-based deposition

Learning Outcomes:

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information