EEE 439 Semiconductor Facilities and Cleanroom Practices (3) [F]

Course (Catalog) Description:
Microcontamination, controlled environments, cleanroom layout and systems, modeling, codes and legislation, ultrapure water, production materials, personnel and operations, hazard management, advanced concepts.
Lecture. Technical Elective.

Prerequisites:
EEE 435 or any course that includes device fabrication or instructor approval.

Textbook: None.

Supplemental Materials:
Ronald Tolliver (Ed.), *Handbook of Contamination Control in Microelectronics*, Noyes, 1988.
W. Whyte (Ed.), *Cleanroon Design,* Wiley, 1991.

Coordinator:
M.N. Kozicki, Professor

Prerequisites by Topic:
1. Fabrication of integrated circuits
2. Basic chemistry of organic and inorganic materials
3. Basic fluid mechanics and thermodynamics
4. Ability to program in a computer language

Course Objectives:
1. Students will be conversant with controlled environment concepts
2. Students will understand and utilize contamination management

Course Outcomes:
1. Students will know what cleanrooms are and how they are used
2. Students will understand the nature of contamination
3. Students will be able to design basic/generic cleanrooms
4. Students will become familiar with the hazard management aspects of cleanrooms

Course Topics:
1. Yield and reliability in semiconductor processing
2. Microcontamination types and sources
3. Controlled environments
4. Performance standards
5. Parameter measurement
6. Construction materials and techniques
7. Air filtration
8. Airflow
9. Decontamination

10. Cleanroon layout
11. Equipment integration
12. Cleanroom modeling
13. Preconditioning, static, and vibration
14. Codes and legislation
15. Ultrapure water: characterization and production
16. Production materials: gases and chemicals
17. Cleanroom apparel
18. Operational practices
19. Hazards and industrial hygiene
20. Hazard management
21. Advanced concepts: microenvironments and robotics

Computer Usage:
The midterm project involves the design of a computer model relating to controlled environments. Students are allowed to use the programming language (or spreadsheet, iterative solver, etc.) of their choice. The model is tested using realistic data obtained by literature review.

Laboratory Experiments:
This is not a laboratory course, but students are typically exposed to a "real" cleanroom by touring the CSSER facility during one of the class periods near the end of the semester.

Course Contribution to Engineering Science and Design:
This course teaches engineering science and design via the application of basic scientific and engineering principles to engineering problems. For example, students use their knowledge of chemistry, physics, and electrostatics to explain aspects of particle behavior in air and on surfaces and to understand how to avoid the problems of electrostatic discharge in integrated circuits. They also use knowledge from engineering core courses, such as fluid dynamics and mass and energy conservation, to design and model controlled environments.

Course Relationship to Program Outcomes:
a: Students are encouraged to apply their broad knowledge of mathematics, science, and engineering (including those disciplines outside EE).
c: Design exercises allow students to solve open-ended design and analysis problems.
e: Students see via examples how to identify, formulate, and solve engineering problems.
g: Report writing improves student ability to communicate effectively.
j: Advanced manufacturing methods are highlighted.
k: Computers and math software are used to model and design controlled environments.

Person preparing this description and date of preparation: Michael Kozicki, April 2008, K. Tsakalis, June 2015.