

## **CHEE 5375**

### **Chemical Processing for Microelectronics**

**Catalog Data:** CHEE 5375-6375: Chemical Processing for Microelectronics Cr. 3. (3-0). Prerequisites: CHEE 4367 or consent of instructor.

Chemical Engineering principles applied to microelectronic device fabrication and processing.

**Textbook:** Richard C. Jeager, "Introduction to Microelectronic Fabrication," second edition, Modular Series on Solid State Devices, Vol. V, G. W. Neudeck and R. F. Pierret, series editors, Prentice Hall, 2002.

Class notes handed out by the instructor.

#### **Prerequisites by Topic:**

1. Knowledge of basic principles of reaction kinetics, mass and heat transport.
2. Knowledge of basic principles of reaction engineering.

**Topics:** (each class is 80 minutes, two classes per week)

1. Overview of microelectronic materials, devices and processing (4 classes).
2. Crystal growth (1 class).
3. Oxidation: growth mechanisms and kinetics, thin oxides, process modeling (1 class).
4. Diffusion: models of solid-state diffusion, non-linear effects (1 class).
5. Ion implantation (1 class).
6. Thin-film deposition: fundamentals of vacuum science and technology, chemical vapor deposition (CVD), physical vapor deposition (PVD), rapid thermal processing (RTP), epitaxy, process simulation (6 classes).
7. Lithography: photoresists, optical lithography, advanced lithographies (2 classes).
8. Plasma Processing: fundamentals of plasmas, plasma reactor design, plasma etching and deposition, process simulation (6 classes).
9. Electrochemical deposition and chemical mechanical planarization (1 class)
10. Thin-film characterization (2 classes).
11. Process integration (3 classes).

## Expected Course Outcomes and Performance Criteria<sup>1</sup>

Demonstrate an understanding of the basic principles and operations governing each of the most important unit processes involved in the fabrication of microelectronic devices. (a,c)

Demonstrate the ability to quantitatively predict the outcome of a given process using simplified engineering models. (a,d,e)

Apply chemical engineering principles to solve problems in areas outside traditional chemical engineering. (d)

Appreciate that microelectronics fabrication is a rapidly developing field and, therefore, they need to update their knowledge continually if they want to stay on top of this field. (i)

### Evaluation:

1. Homework
2. Examinations
3. Project.

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<sup>1</sup> Lowercase letters in parentheses refer to ABET outcomes under Criterion 3 (see Appendix)

## Appendix

ABET Outcome, Criterion 3	Program-Specific Outcomes
(a) an ability to apply knowledge of mathematics, science and engineering.	<ul style="list-style-type: none"> <li>• Use chemistry and physics concepts to set up and solve chemical engineering problems</li> <li>• Use mathematical tools to solve chemical engineering problems</li> </ul>
(b) an ability to design and conduct experiments as well as to analyze and interpret data.	<ul style="list-style-type: none"> <li>• Select appropriate experimental equipment and techniques necessary to solve a given problem</li> <li>• Evaluate and interpret experimental results using statistical tools and chemical engineering concepts</li> </ul>
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, and sustainability.	<ul style="list-style-type: none"> <li>• Apply material and energy balance concepts to design a unit operation</li> <li>• Define objectives and perform the design of an integrated chemical process under realistic constraints</li> </ul>
(d) an ability to function on multi-disciplinary teams.	<ul style="list-style-type: none"> <li>• Define roles and responsibilities to align with capabilities of team members and fulfill project requirements</li> <li>• Develop and carry out a project plan through team work</li> </ul>
(e) an ability to identify, formulate and solve engineering problems.	<ul style="list-style-type: none"> <li>• Translate an engineering problem into a mathematical model or other suitable abstraction</li> <li>• Use mathematical model or other suitable abstraction to solve an engineering problem and interpret results</li> </ul>
(f) an understanding of professional and ethical responsibility.	<ul style="list-style-type: none"> <li>• Demonstrate knowledge of professional code of ethics.</li> <li>• Identify ethical issues and make decisions for a chemical engineering problem.</li> </ul>
(g) an ability to communicate effectively.	<ul style="list-style-type: none"> <li>• Make presentations that are factual and tailored to the audience</li> <li>• Can communicate in writing to non-technical and technical audiences</li> </ul>
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	<ul style="list-style-type: none"> <li>• Understand the impact of chemical engineering solutions in a global, economic, environmental, and societal context.</li> </ul>
(i) a recognition of the need for and an ability to engage in life-long learning.	<ul style="list-style-type: none"> <li>• Recognize the importance of advanced education and development opportunities</li> <li>• Identify, retrieve, and organize information necessary to solve open-ended problems</li> </ul>
(j) a knowledge of contemporary issues.	<ul style="list-style-type: none"> <li>• Know the interplay between current technical and societal issues</li> <li>• Know the recent history, current status, and future trends of chemical engineering</li> </ul>
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	<ul style="list-style-type: none"> <li>• Use modern software to solve chemical engineering problems</li> <li>• Understand how to operate equipment relevant to chemical engineering systems</li> </ul>