## **Mechanical Engineering and Mechanics**

## MEM 417/800 Introduction to Microfabrication

Fall 2006/Spring 2007

**Designation:** Elective

Catalog Description: Covers fundamentals and applications of major microfabrication technologies

such as photolithography, wet and dry etching, metal and dielectric deposition,

soft lithography, polymer micromachining, and wafer bonding.

**Prerequisite:** None

**Textbook:** Fundamentals of Microfabrication, Marc Madou, CRC Press, 2<sup>nd</sup> edition.

**Objectives:** 1. Explain the photochemistry, materials, and processes of photolithography and

analyze the resolution, sensitivity, and photoresist profile for positive and

negative photoresist processes.

2. Describe isotropic and anisotropic wet etching techniques; explain the effects of etch parameters on etch rate, selectivity, and anisotropy; and classify etch stop

techniques.

3. Explain the physics and chemistry of plasma etching and deposition techniques and compare dry and wet etching techniques in terms of etch rate, selectivity and anisotropy.

4. Classify thin-film (metals and dielectrics) deposition techniques and compare them in terms of film quality and residual stress.

5. Describe surface micromachining techniques and different wafer bonding techniques.

6. List polymer micromachining techniques and identify their applications.

7. Design the microfabrication process flow and the photomasks for diverse final products considering process compatibility and manufacturability.

**Topics:** 1. Introduction to Microelectronics and MEMS

2. Photolithography

3. Lab#1 Phitolithography

4. Wet bulk micromachining

5. Lab#2 Wet etching

6. Dry bulk micromachining

7. Thin-film deposition techniques

8. Surface micromachining and wafer bonding

9. Polymer micromachining and electroplating

10. Lab#3 Polymer micromachining

**Class Schedule:** 3 hours/week lecture (3 credits); 3 laboratory classes

## **Contribution to Professional Component:**

Prepares students for the second MEMS course, Microfluidics and Lab on a Chip.

## **RELATION TO ABET CRITERIA 3 OUTCOMES:**

0 = No content; 1 = Some content; 2 = Significant content

Outcomes a - k	Content	Explanation	Evidence
a. An ability to apply knowledge of mathematics, science and engineering	2	This course requires the students to develop a general understanding of microfabrication technologies. The students learn to apply and synthesize their knowledge of engineering and sciences.	Lecture notes, Homework, Lab report, Final exam
b. An ability to design and conduct experiments as well as to analyze and interpret data	1	The students learn to interpret experimental results through lab classes.	Lab report
c. An ability to design a system, component or process to meet desired needs	2	The students learn to design MEMS and their fabrication processes.	Homework, Final exam
d. An ability to function on multidisciplinary teams	0	NA	
e. An ability to identify, formulate and solve engineering problems	2	The problems in homework and exam require students to identify and solve engineering problems related to microfabrication.	Homework, Final exam
f. An understanding of professional and ethical responsibility	1	This is emphasized as part of the engineer's overall responsibility.	Classroom discussion
g. An ability to communicate effectively	1	The students learn writing skill through lab report and paper review report.	Lab report, Paper review report
h. The broad education necessary to understand the impact of engineering solutions in a global/societal context	1	The impact of MEMS and microfabrication on the society is discussed.	Classroom discussion
i. A recognition of the need for and an ability to engage in lifelong learning	1	The need for lifelong learning of emerging technologies is emphasized.	Classroom discussion
j. A knowledge of contemporary issues	0	NA	
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice	2	Diverse microfabrication techniques and equipment are used in laboratory classes.	Lab report

**Prepared by:** Dr. Hongseok (Moses) Noh, 15 November 2006