CpE/EE 446x: Introduction to MEMS (Microelectromechanical Systems)

Semester: Fall 2005
Class Time: Thursday: 6:00-8:30pm.
Classroom: Room 24, Dana Hall.
Instructor: Xingguo Xiong (Assistant Professor)
Office: Tech 140.
Office Hours: Thursday 10:00am-11:00am. Other hours by appointment are welcome.
Phone: 203-576-4760.
Email: xxiong@bridgeport.edu
GA: Patel Bhavin: bhavinp@bridgeport.edu

Description: MEMS (Microelectromechanical Systems) is one of the most important high technologies developed in 20th century. This course covers the fundamentals of MEMS. It includes the introduction to MEMS, basic microfabrication techniques, MEMS materials and their properties, MEMS device design and simulation, working principle analysis, MEMS device fabrication sequence, MEMS packaging and assembly, signal testing, MEMS device case study.

Credit: 3.0.

Textbook: Nadim Maluf, Kirt Williams, *An Introduction to Microelectromechanical Systems Engineering*, Second Edition, ISBN: 1580535909, Artech House, 2004.

Reference:
Stephen Beeby, Graham Ensell, Michael Kraft, Neil White, *MEMS Mechanical Sensors*, Artech House, 2004.
Stephen D. Senturia, *Microsystem Design*, Kluwer Academic Publishers, 2001.
Tai-Ran Hsu, *MEMS & Microsystems: Design and Manufacture*, McGraw-Hill, 2002.
G. T. A. Kovacs, *Micromachined Transducers Sourcebook*, WCB MacGraw-Hill, 1998.
M. Madou, *Fundamentals of Microfabrication*, CRC Press, 2001.
S. M. Sze, Semiconductor Sensors, John Willey and Sons, 2994.

Goals: This course is designed to introduce to students about the fundamental knowledge and skills of state-of-the-art MEMS technology. Basic concepts in MEMS design, working principle analysis, simulation, fabrication and testing will be introduced. MEMS industrial applications in various areas will be discussed. The course project will give students hands-on experience in MEMS device design and simulation. Upon finishing the course, students will have a fundamental understanding about MEMS design, simulation, fabrication and testing.

Prerequisites: Undergraduate and graduate students with engineering or physics background. Only basic knowledge in undergraduate mechanics and mathematics are required.

Topics:

1. Introduction and overview of MEMS
2. MEMS materials and properties.
3. Basic microfabrication techniques.
4. MEMS for industrial and automotive applications.
5. MEMS CAD design and simulation.
6. MEMS for photonic applications.
7. MEMS for life sciences applications.
8. MEMS for RF applications.
9. MEMS packaging and reliability considerations.
10. MEMS fault testing.

Grading: The final grade will be 15% on homework, 40% on project, 20% on mid-term exam and 25% on final exam.

Exams There will be two exams: the mid-term exam and the final exam.

Computer Usage: PC (ANSYS software).

Lab Project: Three lab projects on MEMS devices design and simulation will be assigned. The goal of the projects is to help student accumulate skills and experience in MEMS CAD design and simulation. Students will use CAD tools (ANSYS) to build the device model, and simulate its response to input stimulus. ANSYS software is installed in department computer lab. ANSYS software tutorials will be given before the project. Through this project, students will get familiar with MEMS design and its performance analysis.