

EECS 179 MICROELECTROMECHANICAL SYSTEMS (MEMS)
(Elective)

- Catalog Data:** **EECS 179 Microelectromechanical Systems (MEMS) (Credit Units: 4)** Small-scale machines, small-scale phenomena, MEMS fabrication, MEMS CAD tools, MEMS devices and packaging, MEMS testing. Prerequisite: Physics 51A or consent of instructor. Formerly ECE119. (Design units: 2)
- Textbook:** Maluf, Nadim, *An Introduction to Microelectromechanical Systems Engineering*, Artech House, 2000.
- References:**
- Coordinator:** Peter J. Burke
- Course Objectives:** Teach students about new applications and directions of modern engineering.
Teach the techniques for building microdevices in silicon, polymer, metal and other materials.
Teach the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.
Critically analyze microsystems technology for technical feasibility as well as practicality.
Discuss the limitations and current challenges in microsystems technology and indicate future needs and directions.
- Course Outcomes:** Students will:
Describe new applications and directions of modern engineering.
Describe the techniques for building microdevices in silicon, polymer, metal and other materials.
Describe the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.
Critically analyze microsystems technology for technical feasibility as well as practicality.
Describe the limitations and current challenges in microsystems technology.
- Prerequisites By Topic:** Students should be familiar with basic physics, chemistry, electronics and mechanics at the sophomore level. Understanding of physics to the level of Physics 51A. Understanding of engineering materials at the level of E 54, a sophomore-level course. Understanding of electronics and semiconductors to the level of EECS170A, basic semiconductors and electronics.
- Lecture Topics:** Introduction to class and overview of microsystems Microfabrication methods 1, lithography and bulk micromachining Microfabrication methods 2, surface micromachining techniques Microfabrication methods 3, non-traditional techniques Overview of MEMS sensors and actuators MEMS pressure sensors and transducers MEMS accelerometers and gyroscopes Overview of biomedical MEMS; Microfluidic chips

Minimally invasive devices; Overview of telecom microdevices Optical MEMS devices; RF MEMS devices What's next: MEMS, NEMS, microfactories and nanotechnology.

Class Schedule: Meets for 4 hours of lecture each week for 10 weeks.

Computer Usage: Computer usage is not required, however, all lectures are available from the course website, as well as test scores, test keys, downloadable notes, and interactive links.

Laboratory Projects:

Professional Component: Contributes toward the Electrical Engineering Major Design experience.

Relationship to Program Outcomes: This course relates to Program Outcomes a, c, e, f, h, I, j and k as stated at:

<http://undergraduate.eng.uci.edu/degreeprograms/electrical/mission>

Design Content Description

Approach: Students are expected to critically analyze micro-device designs currently in commercial markets or in development for commercial deployment. Their analysis should reveal strengths and weaknesses of the designs as they relate to performance, manufacturability, and suitability to solving the application problem. Content is highly interdisciplinary and students are encouraged to think outside their traditional areas of expertise in order to solve problems for a wide variety of markets.

100% of design content. During lectures, many micro-device examples are provided and their design issues are discussed. Discussion includes device design as well as manufacturing design (usually critically linked to the design of the devices) and market design (price, reliability, market acceptance). Famous successful devices are presented as well as many historical failures, with discussion of their reasons for success or failure. Students are expected to apply these skills in the quizzes and on the final exam by designing or analyzing basic transducers, describing their performance, and specifying their manufacturing process.

Lectures: 100%

Laboratory Portion: 0%

Grading Criteria:

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|-------------|------------|
| Quiz 1: | 15% |
| Quiz 2: | 15% |
| Quiz 3: | 15% |
| Quiz 4: | 15% |
| Final exam: | <u>40%</u> |
| | 100% |

Optional research paper to replace one quiz grade (15%).

Estimated ABET Category Content:

Mathematics and Basic Science: 0 credit units or 0%

Engineering Science: 2 credit units or 50%

Engineering Design: 2 credit units or 50%

Prepared by: Peter J. Burke **Date:** July 2007

CEP Approved: Fall 2004