

**University Of California, Berkeley**  
**Department of Mechanical Engineering**

**ME C219 – Parametric and Optimal Design of MEMS [3 Units]**  
**Graduate Course**

*Syllabus*

**ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM):** Design of MEMS

**GRADING:** Letter

**SEMESTER OFFERED:** Spring

**COURSES THAT WILL RESTRICT CREDIT:** None

**INSTRUCTORS:** Professors Lin and Pisano

**DURATION OF COURSE:** 15 weeks

**EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK:** 9

**IS COURSE REPEATABLE FOR CREDIT?** No

**CROSSLIST:** Electrical Engineering C246

**CATALOG DESCRIPTION**

Parametric design and optimal design of MEMS. Emphasis on design, not fabrication. Analytic solution of MEMS design problems to determine the dimensions of MEMS structures for specified function. Trade-off of various performance requirements despite conflicting design requirements. Structures include flexure systems, accelerometers and rate sensors. Various design and optimization methods used to determine numerically and analytically the design. This course presumes familiarity with MEMS fabrication processes.

**COURSE PREREQUISITES**

ME119 or ME C218 (EE245) or Consent of Instructor

**TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL**

None

**COURSE OBJECTIVES**

The student will develop an advanced understanding of the applications of MEMS as well as the parametric analysis of MEMS devices. The student will develop deep understanding of the use of flexural elements in MEMS as well as the design techniques for accelerometers and angular rate sensors. Deep understanding of parametric optimization techniques will be achieved. Both analytical and numerical techniques will be understood and practiced. The process of engineering tradeoff will be formalized, and analytical techniques for evaluating the result of such tradeoffs will be taught. The effect of fabrication technique on the manufacturability of MEMS will be understood. Techniques of reverse-engineering will be learned and used to improve the performance of MEMS accelerometers.

## **DESIRED COURSE OUTCOMES**

The student will be able to design and optimize a variety of MEMS devices, including accelerometers, rate gyros and motion sensors. The student will be able to modify designs of MEMS devices in order to achieve various technical goals, including lowest cost, highest performance and ease of manufacture. The student will be able to determine what is possible and what is not possible in terms of cost reduction as well as performance increase.

## **TOPICS COVERED**

- MEMS technology overview and applications of MEMS to commercial products.
- MEMS elastic analysis and application to accelerometers, rate gyros and resonators.
- Monotonicity Analysis and other tools of parametric design.
- Analytical and numerical optimization theory and practice.
- Design examples and reverse engineering of commercial MEMS products.

## **CLASS/LABORATORY SCHEDULE**

Class: MWF 9-10

## **CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT**

The student will learn to develop practical MEMS designs that fulfill both engineering specifications as well as cost and manufacturability targets. All work will be done in an industrial-style environment utilizing student teams and design reports instead of traditional examinations and quizzes.

## **ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES**

- # Homework assignments (100%)
- # Quizzes (0%)
- # Midterm projects (0%)
- # Final examination (0%)

## **PERSON(S) WHO PREPARED THIS DESCRIPTION:**

Professor Albert P. Pisano & Ms. Shareena Samson