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
TIE CODE: LECN
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 will be applied to MEMS, with an emphasis on design and not on fabrication. The format of the course will be oriented toward design projects. The student will learn to rigorously formulate MEMS design problems analytically and then determine the correct dimensions of MEMS structures so that the specified function is achieved. The formulation will allow the student to trade off various performance requirements and thereby develop a rational design compromise solution when faced with conflicting design requirements. A variety of MEMS structures will be treated in this class, including flexure systems, accelerometers and rate sensors. A variety of design and optimization methods will be used to determine numerically and analytically the design. This course presumes the student is already familiar with a variety of basic MEMS fabrication processes. ME 119 and ME C218 / EE C245 are highly recommended (but not mandatory) prerequisites.

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