Goals: To analyze and design MEMS transducers utilizing principles of sensing and actuation, properties of materials available for fabrication, microfabrication technologies, and understanding of circuit and system issues, packaging, calibration, and test.


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Prerequisites: This course is intended for graduate and upper-level undergraduate students with any engineering or physics background. Prerequisites by topic: 1) Differential and integral calculus; 2) Introductory circuit theory; and 3) Statics.

Topics
1. Introduction and Orientation
   - Overview of MEMS
   - Sensors and actuators technologies
2. Fabrication Technology
   - Review of standard IC fabrication technologies - diode, BJT, CMOS
   - MEMS fabrication technologies - bulk micromachining, surface micromachining, and CMOS micromachining; bonding technologies
3. Mechanical Behavior
   - Mechanics: stress, strain, bending, beam-mass systems
   - Lumped-element modeling of static behavior of elementary beams, membranes and plates
   - Effects of residual stress and stress gradients
   - Dynamics, normal modes, damping
4. Transduction Principles
   - Capacitive, inductive, magnetic, optical, piezoresistive, and piezoelectric methods
5. Pressure Sensors and Accelerometers
   - Case studies based on the MEMS literature.
6. Resonant Sensors and Drive Circuits
   - Principles of resonant sensors and drive electronics; RF MEMS
7. Optical MEMS
   - MEMS mirrors and gratings for optical displays, switching and imaging

Grading: Homework (20%), 2 Tests (50%) , Design Project (30%), no Final Exam

Computer Usage:
- Layout of masks and FEM simulation using Coventorware, circuit simulation using P-SPICE, and dynamics calculation using Matlab, Mathcad, or Mathematica.