MEMS Design

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Office hours: Friday afternoon 1:30 ~2:30

Course ID: P49360
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I) Course goals

II) Information Sources

III) Course outline

IV) Homework and term project policy
Course Goals

• Introducing to basic IC design and mask layout
  - MOS
  - L-Edit & MEMS designer

• Introducing MEMS design and foundry services
  - MOSIS (Orbit 2μm)
  - MCNC

• Understanding micro sensors and actuators properties and operation.

• Case study for MEMS design

• Term project to design your own micro sensor and actuator based on MOSIS or MCNC.
Textbook and Paper Collections

Lecture notes

Reference Books:
“MEMS & Microsystems Design and Manufacture”, by Tai-Ran Hsu
“Microsystem Design”, by Stephen D. Senturia
“Micromachined Transducer Sourcebook” by Gregory T. A. Kovacs
“Semiconductor Sensors” by S. M. Sze

Paper collections:
“Micromechanics and MEMS-classic and seminal papers to 1990” edited by W. S. Trimmer, IEEE
Micromachined Transducers Meetings

• *Solid-State Sensor and Actuator Workshop*, or *“Hilton Head”* (small, North American only, limited attendance meeting held at Hilton Head, SC, on alternate years, e.g., 1992, 1994, 1996, ...).

• *International Conference on Solid-State Sensors and Actuators*, or *“Transducers”* (large, international meeting held in Asia, North America, or Europe on alternate years, e.g., 1991, 1993, 1995, ...).

• *Micro Electro Mechanical Systems Workshop*, or *“MEMS”* (moderate sized, international workshop, with a focus on actuators and mechanical devices, held annually).

• *Micro Total Analysis Systems*, or *“μTAS”* (international, focus on micromachined chemical systems, held alternate years in Europe, e.g., 1994 (first), 1996, ...).

• *Euroensors* (European, with broad coverage, held annually).
Journals

**Journals with a primary focus in MEMS areas:**
- Journal of Microelectromechanical Systems (JMEMS)
- Journal of Micromechanics and Microengineering
- Microsystem Technologies: Sensors, Actuators, Systems Integration
- Journal of Smart Materials and Structures
- Sensors and Actuators A (Physical)
- Sensors and Actuators B (Chemical)
- Sensors and Actuators C (Material)

**Journals with information of interest to the MEMS community:**
- IEEE Electron Device Letters
- Journal of Electrochemical Society
- Journal of Vacuum Society
- Proceedings of SPIE – International Society for Optical Engineering
- Journal of Analytical Chemistry
On-Line Resources

- http://www.people.cornell.edu/pages/akt1/memsmain.html
  - MEMS Virtual Learning Cybercenter and the MEMS Education Pages.
- http://www.mosis.com
  - MOSIS foundry service.
- http://www.memsrus.com/CIMSmain2ie.html
  - MUMPS foundry service.
- http://www.darpa.mil
  - MEMS research projects funding source in USA
- http://mems.isi.edu
  - MEMS clearinghouse BBS at ISI of USC.
- “Fundamentals of Microfabrication” Marc Madou Appendix B shows most of MEMS related web page addresses.
- http://mems.walsin.com.tw 華新麗華設立於楊梅之微系統晶圓廠，為全球第一座提供4到8吋微系統晶圓 製程服務之專業代工廠
MEMS Design Tentative Outline

Ch 0: Introduction to MEMS design: Course introduction

Ch 1: Introduction to MOS Technology: Basic MOS Circuit, MOS Circuit Design

Ch 2: MOS fabrication process: NMOS mask layout and L-Edit software

Ch 3: MOSIS foundry service


Ch 5: Micro Hot Wire

Ch 6: CMOS Fabricated Micromechanical Structures

Ch 7: Introduction to Accelerometer

Ch 8: Accelerometer design based on MOSIS rules

Ch 9-12: Bulk micromachined accelerometer: static, dynamic, sensor system and fabrication

Ch 13: MUMPS Foundry Services: Micro motor design

Ch 14: Electrostatic micro actuator: Comb drive design

Ch 15: Magnetic actuator

Ch 16: Thermal actuator

Ch 17: Piezoelectric actuator

Ch 18: Shape memory alloy actuator

Ch 19: Pneumatic actuator

Ch 20: Term project presentation
Grade Policy

Assignments\(^1\) 30
Quiz 40
Term project & presentation\(^2\) 30

(Total of 100)

1. Assignment includes *reading*, research, and problem solving. Please prepare a floppy disk for layout program. Some layout homeworks have to be submitted by email to tsleu@mail.ncku.edu.tw or floppy disk.
2. You propose the topic of the term paper (subject to approval) mid semester.
3. No late assignments and term paper acceptable!
4. Lecture notes can be downloaded from http://www.iaa.ncku.edu.tw/~aeromems/index.htm