EEL6935 Advanced Microsystem Technology
Fall 2006 Semester

Tuesdays: Periods 8-9; Thursdays: Period 9

Credits: 3

Goals: To develop expertise in the MEMS field through studying in depth advanced micro/nano fabrication technologies, microsystem design, interface circuits design and MEMS packaging; and also to gain experience on proposal writing through supervised, peer-reviewed projects. The emphasis will be on CMOS MEMS, optical MEMS and RF MEMS for Fall 2006.

Instructor: Dr. Huikai Xie
Electrical & Computer Engineering; 221 Benton Hall; 846-0441; hxxie@ece.ufl.edu

Meeting Time:

Guest Instructors: Drs. David Arnold, Toshi Nishida and Mark Sheplak

Prerequisite: EEL5225 or permission of instructor

Textbook: No required textbook. Lecture notes and supplemental materials will be handed out.

Reference Books:

Topics

1 Advanced Micro/Nano Fabrication Technologies
   - Plasma physics, high-density plasmas, deep Si etch, deep oxide etch
   - Surface micromachining: MUMPs, SUMMiT, thick poly-Si, tensile stress thin films, etc.
   - Surface/bulk micromachining (SBM): SOI, polymers, through-wafer vias, etc.
   - CMOS-MEMS: thin-film, bulk, DRIE

2 Sensing: CMOS-based Sensors and Interface Circuits Design
   - CMOS MEMS inertial sensors
     o Lagrange’s Equation
     o Fabrication: surface, DRIE and SOI
     o Interface circuits: CHS vs. CDS
   - CMOS MEMS chemical sensors
     o Polymer coatings
     o Metal oxides
     o ISFETs

3 Actuation I: Optical MEMS
- Fundamentals of light: Propagation, Interference, Diffraction, Polarization
- Introduction to fiberoptics
- Optical MEMS devices: micromirrors, microlens and microgratings
- Applications
  - Optical communications: phase modulators, attenuators, switches, add/drop, VCSELs
  - Displays, Scanners
  - Biosensors, Spectroscopy; Biomedical Imaging

4 Actuation II: RF MEMS
- RF MEMS Introduction
- CMOS-compatible RF MEMS devices:
  - Switches, Inductors, Varactors, Resonators, Antennas

5 MEMS Packaging
- Packaging design, materials
- MEMS packaging techniques: Bonding, Sealing, Dicing, Wafer-level packaging
- Packaging for medical, aerospace and RF MEMS applications

Grading: 25% Homework/Mini-projects, 35% Test, 40% Design Project

Design Project:
Project topics will be provided. Students can also propose new topics. Team projects are encouraged. All projects will be peer-reviewed at both proposal and final stages. Your score will be based on the evaluations of the instructor and your peers.

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