

Fall 2009 – EML4930/5930: Introduction to Micro and Nano Scale Science and Engineering
Course Syllabus
CEB A223 - MW 9:15-10:30

Instructor: Dr. Ongi Englander

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Office hours: Monday 10:30am-12:30pm or by appointment

Class info, supplementary materials, etc are available on course Blackboard site

Course Description

An overview of microfabrication methods and techniques as applied to surface and bulk micro machining of micro electromechanical systems (MEMS) and integrated circuits. MEMS design and actuation. Unique nanostructures and nanoscale phenomena. Paradigms for nanofabrication and nanoscale processing. Methodologies for nano-micro integration and emerging nano electromechanical systems (NEMS) and nanoelectronics.

Course Objectives

This course is intended to serve as an introduction to microscale and nanoscale fabrication methods and techniques, micro electromechanical systems (MEMS) and emerging nano electromechanical systems (NEMS).

Upon completion of this course students should:

- Understand capabilities and limitations of various microfabrication techniques
- Be able to develop process flows for the fabrication of microscale components, and micro-nano integrated systems
- Understand MEMS sensing and actuation mechanisms
- Describe key parameters in transistor operation
- Describe bottom-up synthesis processes for nanostructures
- Describe contents of micrographs displaying micro/nano structures/systems/devices
- Develop an appreciation for the interdisciplinary nature of working at small length scales
- Understand the opportunities and challenges offered by nanotechnology

Textbooks

Required:

S.A. Campbell, *Fabrication Engineering at the Micro and Nanoscale*, Oxford, 2008, 3rd Edition.

Supplementary/reference:

M. Madou, *Fundamentals of Microfabrication*, CRC Press, 2002.

S. Senturia, *Microsystem Design* (available online).

N. Maluf, *An Introduction to Microelectromechanical Systems Engineering* (available online)

M. Gad-el-Hak, *The MEMS Handbook* (available online).

M. Di Ventra, S. Evoy and J.R. Heflin, *Introduction to Nanoscale Science and Technology* (available online).

Topics

Microfabrication processes and technologies
MEMS – devices, actuation, design & packaging
Issues in MEMS processing
A brief introduction to integrated circuit technologies
Nanofabrication methods
Nanostructures
Micro-nano integration
Nanoscale applications & devices (NEMS)

Grading Policy

Undergraduate Students		Graduate Students	
Exam I	20%	Exam I	20%
Exam II	25%	Exam II	25%
Assignments/quizzes	30%	Assignments/quizzes	25%
Paper presentation	20%	Literature review	25%
Attendance & participation*	5%	Attendance & participation*	5%

**classroom and laboratory attendance & participation*

Homework assignments:

Assignments will be due at the beginning of class (hard copies or online). Late assignments **will not be** accepted. Instructor will make announcements (on Blackboard) regarding assignment due dates. Assignments should be completed individually. Discussion with other students is recommended, but copying from each other is NOT. A grade of '0' will be assigned for all parties involved in copied assignments.

Quizzes:

Quizzes will be administered in class and may or may not be announced.

Hands-on experience:

A number of laboratory sessions will be conducted at the FAMU-FSU cleanroom (room A210). These laboratory sessions seek to give students exposure to the cleanroom environment and as well as an introduction to basic microfabrication processes and equipment. You must attend the lab sessions as well as the required lab safety training. Signups for lab sessions will take place in class.

Undergraduate semester project: Paper presentation

Undergraduate students, working in groups of 2-3 students, will present and lead a class discussion about a selected journal paper from the current literature. Potential journal articles will be posted on Blackboard and each group must select a paper and sign up for a presentation date in class. Presentation grades will combine instructor evaluation and peer evaluation.

Graduate semester project: Literature review

Graduate students (working individually) will select a topic with instructor approval, then survey the current literature and write a comprehensive overview of topic. Topic areas should address current issues in micro/nano scale science/engineering. Your topic should be well defined and not overly broad so it is manageable. The scope and focus of your topic can be developed with instructor input. Potential project topics will be due in mid October. The paper will be due on Friday December 4th. Details regarding paper formatting, length, number of required references, etc. will be provided.

Grades will be assigned as follows:

grade \geq 90%	A
80% \leq grade $<$ 90%	B
70% \leq grade $<$ 80%	C
60% \leq grade $<$ 70%	D
grade $<$ 60%	F

Learning outcomes

- An ability to apply knowledge of mathematics, calculus based science and engineering to mechanical engineering problems.
- An ability to use modern engineering techniques, skills, and computing tools necessary for engineering practice.
- An ability to identify, formulate, and solve engineering problems.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context, and a knowledge of contemporary issues.
- Recognition of the need for, and an ability to engage in life-long learning.
- An ability to communicate effectively with written, oral, and visual means.

Attendance Policy: The universities require attendance in all classes.

Make Up Course Work Policy

Exams are mandatory—should a scheduling conflict arise, please schedule a makeup exam *in advance*. In general, no late make up exams will be given; if special circumstances, such as a medical emergency, exist, the student is expected to communicate these as soon as possible.

Academic Honor Code

Students are expected to uphold the Student Code of Conduct, Academic Honor Code published in their University Bulletin and/or Student Handbook.

Florida A&M Student Code of Conduct is published in the Student Handbook, The FANG 2004-2007, Academic Honesty Violations p.122. The academic honor policy is also defined in the University regulations, together with potential penalties for violations.

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to '...be honest and truthful and...[to] strive for personal and institutional integrity at Florida State University' (Florida State University Academic Honor Policy, found <http://www.fsu.edu/~dof/forms/honorpolicy.pdf>.)

ADA Policy

Students with disabilities needing academic accommodation should:

- (1) register with and provide documentation to the Student Disability Resource Center;
- (2) bring a letter to the instructor indicating the need for accommodation and what type.

This should be done during the first week of class.

For more information about services available to FAMU students with disabilities, contact:

The Learning Development and Evaluation Center (LDEC)
677 Ardelia Court
(850) 599-3180/ (850) 561-2512 (FAX)
<http://www.famu.edu/index.cfm?a=EOP&p=ADA>

For more information about services available to FSU students with disabilities, contact:

Student Disability Resource Center
97 Woodward Avenue, South
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice) / (850) 644-8504 (TDD)
sdrc@admin.fsu.edu / <http://www.disabilitycenter.fsu.edu/>

Syllabus Change Policy:

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.