Syllabus

Course Administration

Lecturer	**Graduate Assistant**
Prof. Issam Lakkis	xxx
Office: FEA Bechtel 410 *Tel:* x–3636	
E-mail: `issam.lakkis@aub.edu.lb`	`xxx@aub.edu.lb`

Office hours: MW 3:30 PM – 5:00 PM
Lectures: MW 2:00 – 3:15 PM
Bechtel 537

Welcome to MECH 631!

Micro-electromechanical systems are small devices that preform specific tasks that include sensing, control and actuation. Successful MEMS devices such as pressure sensors and accelerometers have been available since the seventies and could be found nowadays in modern cars. Since early 1990s MEMS research progressed significantly to include fields such as radio frequency applications for wireless communications, optics for sensing and projection display, and microfluidics for clinical diagnostics and laboratory tests. This course will introduce to MEMS applications, fabrication techniques and materials. Various MEMS design methodologies are discussed with focus on reduced order modeling. Physics of various MEMS devices will be covered and case studies of different MEMS devices will be considered.

Educational objectives

The objectives of this course are to

1. introduce MEMS materials, fabrication and applications.
2. provide a clear overview of the various MEMS design methodologies.

3. equip the students with skills for modeling MEMS devices that combine multiple disciplines of physics.

4. consider MEMS design challenges on the device level, system level and packaging level.

5. discuss various commercial MEMS devices as case studies.

Textbook

The suggested text is *Microsystem Design* by Stephen D. Senturia (Kluwer Academic Publishing, 2001).

Moodle

We expect to use Moodle for course announcements. Course handouts, Problem Set solutions, Exams solutions and additional material will be available in "pdf" formats form Moodle in a timely fashion.

Problem sets, exams and grading

The final grade in the course will be based upon analytical homework assignments, a midterm, and a project class performance weighted as follows:

- 10 % Presentations:
- 20 % Homework assignments: Problem Sets will be assigned and collected at the end of the lecture on the due date.
- 25 % Midterm or Final: 120 minutes. Closed book. Will be given in class.
- 45 % Project.

The above percentages may vary from one semester to the other.

Office Hours

Your are encouraged (and even expected) to come by and see me during office hours to ask any questions you have. Please be advised that I will not be able to answer or discuss course related questions outside the office hours.

Collaboration and honesty rules

- No collaboration or cheating is allowed in the exams.
- No collaboration on problem sets as long as (1) you acknowledge your collaborator(s) on each problem, (2) you spend independently enough time on each problem, and (3) you write the solution in your language in a manner that reflects your understanding and problem solving approach. Collaboration is encouraged in the sense of discussing topics and problems among your fellow students as well as approaches to solving these problems.

Course outline

This is a tentative outline. It will most likely change as we progress.

1. Introduction
2. Scaling Issues in MEMS
3. MEMS fabrication techniques. Surface micromachining. Bulk Micromachining. Standard MEMS fabrication processes.
4. MEMS materials.
5. MEMS sensing and actuation
6. MEMS design methodologies. Reduced order modeling of MEMS devices.
7. System level design considerations and packaging.
8. Case studies.

References

1. Madou, M. J., Fundamentals of Microfabrication, CRC Press, 1997.
2. James J. Allen, Micro Electro Mechanical System Design (Dekker Mechanical Engineering), CRC Press, 2005.
3. Mohamed Gad-el-Hak, MEMS: Introduction and Fundamentals, CRC Press, 2005.
4. Maluf, N., An Introduction to Micromechanical Systems Engineering, Archtech House, 2000.

5. Gardner, Microsensors, Principles and Applications, Wiley, 1994.

6. Hau, Tai-Ran, MEMS and Microsystems: design and manufacture, McGraw Hill, 2002.

7. Mohamed Gad-el-Hak, The MEMS handbook, CRC, 2005.