

ME 409 Foundations of Microsystems

Fall 2022

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Text: Lecture notes.

Prerequisites: Senior or First Year Graduate Standing in Engineering.

Grading: Homework 20%, Midterm 20%, Final Exam 20%, Term Project 20%, Attendance +Quizzes 20%

Course Description: ME 409 (a three credit course) is designed for upper class undergraduate and entry-level graduate students to give an introduction to microsystems technology. The following topics will be covered: 1- Overview on microsystems, 2- Fabrication of microsystems, 3- Working principles of Microsystems: Sensors and Actuators, 4- Analysis and modeling of Microsystems, 5-Thermal-fluid Engineering and Thermodynamics in Microsystems, 6- Microsystem packaging, 7-Microfluidics and Nanofluidics.

Goals:

- To give a broad introduction to microsystems technology
- To give students an opportunity to study the current literature
- To provide understanding in theory and analysis on microsystems
- To help students gaining insight into microsystems design

Reference Books:

- MEMS and Microsystems: Design and Manufacture, Tai-Ran Hsu, Mc Graw Hill , 2002, ISBN 0-07-239391-2
- Fundamentals of Microfabrication, Marc Madou, CRC Press, NY, 1997.
- Nadim Maluf, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2000.
- Microsystems Design, Stephen D. Senturia, 2001, ISBN 0792372468

Journals:

- J. Microelectromechanical Systems (IEEE/ASME)
- Sensors and Actuators (Elsevier)
- J. Micromechanics and Microengineering (IOP)
- Scientific Reports
- Nature Communications

Co-operation on coursework:

It is encouraged to discuss with classmates, use texts, library materials, and other sources while doing any assignment. If a solution to a problem is found in the literature, students must provide correct citations to that literature. For the homework assignments, every student is expected to have worked **through his/her own analysis and to have written up his/her own work for submission**. Under no circumstances is it permitted to present another student's work as one's own. For term projects, a single report from each team is to be prepared.

Term Project:

Each team (consisting of 2 students) will select one topic for the project related to this course. The project will be a design project related to the topic. In this project design, technical drawing and analysis should be included and fabrication is required. The title of the topic and abstract (250-300 words) should be submitted for instructor's approval prior to working on the project. This will be due early November. The project report should be approximately 10-12 pages long and will be due to the first day of project presentations.

The written report must be in the style of a review journal article (like a Journal of Microelectromechanical Systems article) having the typical format as follows: Title, Author's Name and Affiliation, Abstract, Objectives, Theory and Analysis, Technical Description, Results and Discussion and References. Plagiarism will be severely punished and result in a "zero" grade for written portion of the term project. Project Presentations will be given to the rest of the class in the last week of classes at regular class hours.

Course Outline (Subject to change)

Week/ Dates	Subjects	Text Reference
1	Overview of MEMS and Microsystems	Lecture notes
2-4	Microfabrication Fundamentals	Lecture notes
5	Working Principles of Microsystems	Lecture notes
6	Project Progress Report Presentations	
7	Midterm Exam	
7-8	Engineering Mechanics for Microsystem Design	Lecture notes
9-10	Thermofluid Engineering and Thermodynamics	Lecture notes
11	Scaling Laws	Lecture notes
12	Microsystem Packaging	Lecture notes
13	Microfluidics and Nanofluidics	Lecture notes
14	Project Presentations	

