ECE4813: Introduction to Microelectromechanical Systems (MEMS)

Instructor: Dr. A. Bruno Frazier

Credit Hours: 3-0-3

Lecture Period: TBD

Pre-Requisite: ECE2040

Textbook: An Introduction to Microelectromechanical Systems Engineering, ISBN: 978-1580535908

Author: Nadim Maluf

References:

1. Fundamentals of Microfabrication. Author: Marc J. Madou, ISBN # 0-8493-0826-7
2. Fundamentals of MicroSystems Packaging. Author: Rao R. Tummala, Publisher: McGraw-Hill, ISBN # 0-07-137169-9
3. Semiconductor Sensors. Editor: S.M. Sze, Publisher: John Wiley & Sons, ISBN: 0-471-54609-7
4. Microfluidics and BioMEMS Applications. Author: F. Tay, Publisher: Kluwer Academic Publishers, ISBN#: 1-4020-7237-6
5. Modeling MEMS and NEMS. Authors: J.A. Pelesko, D.H. Bernstein, Publisher: CRC Press, ISBN#: 1584883065

Course Organization:

1. Design Project 1: Fabrication Process Flow Design (25%)
2. Presentation on Advanced Fabrication Technology (20%)
3. Presentation on Micro System Application (20%)
4. Presentation Quizzes (10%)
5. Design Project 2 (Final Exam): MEMS Device Design - MicroSystem Design, Layout, and Fabrication (25%)

Design Projects: The Design Projects will challenge the students to form a complete train of knowledge from micro system design / layout through the design of the MEMS fabrication process.

Presentations: There will be two technical presentations (12 minute + 3 minutes for questions) by each student. The topic of the first presentation will be advanced MEMS fabrication technologies. The second presentation will be on the design options, fabrication approaches, and performance results of a course relevant micro system. The presentations will be graded with 11 pts. for the presentation content and 4 pts. for the presentation effectiveness.

COURSE OBJECTIVES: Upon successful completion of this course, students should be able to:

1. Understand the underlying principles of microelectomechanical systems operation
2. Understand the fabrication technologies associated with MEMS
3. Design a fabrication process flow for basic MEMS
4. Recognize sensing and actuating applications of MEMS
5. Understand the underlying MEM driving principles
6. Read MEMS technical literature with a basic understanding

LEARNING OUTCOMES: As part of ECE4452, the students are expected to become familiar with:

1. Relevant MEMS fabriation technologies
2. Relevant MEMS driving forces
3. Design of fabrication process flows
4. Applications of the technologies to the development of micro instrumentation (including detection methodologies)
5. Design of basic microelectromechanical systems

DIVERSITY AND DISABILITY STATEMENT: Georgia Tech values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that results in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible. Students with disabilities should contact the Office of Disability Services to discuss options of removing barriers in this course, including accommodations. ODS can be reached at 404.894.2563,dsinfo@gatech.edu, or disabilityservices.gatech.edu

GEORGIA TECH HONOR CHALLENGE STATEMENT: I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Georgia Tech community.

GEORGIA TECH HONOR AGREEMENT: Having read the Georgia Institute of Technology Academic Honor code, I understand and accept my responsibility as a member of the Georgia Tech community to uphold the Honor Code at all times. In addition, I understand my options for reporting honor violations as detailed in the code.

GEORGIA TECH ATTENDANCE POLICY: http://www.catalog.gatech.edu/rules/4/

Tentative SCHEDULE for ECE4813
Introduction to Microelectromechanical Systems (MEMS)

Lecture Number	Lecture Topics
August	Introduction to Course, History of MEMS
August	Driving Forces for Biomedical Relevant Actuators and Geometrical
August	Scaling Effects on Sensors and Actuators
September	Presentations on Driving Forces for Microactuators
September	MEMS Materials
September	Crystal Growth Techniques
September	MEMS Deposition Processes
September	MEMS Lithographic Processes
September	Wet Etching of MEMS Materials
September	Dry Etching of MEMS Materials
September	Micro Molding and Microelectroforming Technologies
September	Metal Microstructures Lab
October	Polysilicon MEMS Technologies
October	Bonding Technologies, Microchannels
October	MEMS Plastics Technologies
October	Design of MEMS Process Flows
October	Design of Process Flow
October	Technical Presentations on Process Flow Designs
November	Sensor Overview and Common Sensing Principles
November	Physical Sensors (Pressure Sensors, Accelerometers, Flow Rate Detectors)
November	Automotive Sensors
November	Optical Sensors
November	Environmental Sensors and Biosensors
November	Magnetic Sensors
November	Biomedical Microsystems
November	Technical Presentations
December	Final Exam