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School of Engineering and Computer Science

MECH 450/550: Advanced Topics in Micro and Nano Technology

Catalog Data:	**450 Advanced Topics in Micro and Nano Technology** 3 (2-3) Course Prerequisite: CHEM 106; PHYSICS 202. Microfabrication technology, bulk and surface micromachining, sensors and actuators, microelectromechanical systems (MEMS), nanofabrication technology, micro/nano scale material and device measurements. Credit not granted for both MECH 450 and MECH 550. Offered at 400 and 500 level. Typically offered Spring.
Class Schedule:	Two 50-min lecture sessions per week, for one semester
Laboratory Schedule:	One three-hour lab session per week
Prerequisites by Course:	CHEM 106; PHYSICS 202
Prerequisites by Topic:	1. Crystal structures 2. Dynamic of particles 3. Electricity and magnetism 4. Stress and strain 5. Axial loads, torsion, and bending
Textbook:	Marc J. Madou, *Fundamentals of Microfabrication: The Science of Miniaturization*, Second Edition, CRC Press, 2002
Course Coordinator:	Dr. Jong-Hoon Kim
Course Objectives:	1. Learn the principles and mechanisms of microfabrication technology. 2. Understand the bulk and surface micromachining techniques. 3. Be familiar with the essential electrical and mechanical concepts for microdevices and microsystems. 4. Understand the sensing and actuation principles for microdevices. 5. Be familiar with different sensors and actuators. 6. Obtain the fundamental knowledge MEMS. 7. Learn the concepts of nano scale materials, nanofabrication, and nanodevices. 8. Understand various measurement systems for micro/nano scale materials and device characterization.
Topics Covered:	1. Semiconductor materials and crystal structures 2. Introduction to microfabrication and MEMS 3. Optical lithography and photoresist 4. Bulk micromachining 5. Surface micromachining 6. Sensors and actuators 7. MEMS CAD and simulation programs 8. Measurement systems: scanning electron microscope (SEM) and atomic force microscope (AFM) 9. Nano materials, nanofabrication, and nanodevices 10. Novel micro and nano fabrication techniques
Lab Experiments and Activities:	1. Introduction to the Device Diagnostics and Microelectronics Laboratory: lab safety policy, fabrication equipment, and measurement equipment. 2. MEMS CAD: mask design and pattern generation. 3. Lithography: transfer the structures from mask to silicon wafers. 4. Silicon dioxide etching: wet etching of SiO_2, remove SiO_2 layers using buffered oxide etchant. 5. Silicon etching: wet etching of Si wafers, produce 3D microstructures. 6. Measurement of 3D microstructures: SEM inspection of the fabricated devices.

		7. Measurement of surface profile of the microstructures; Inspection on the topography of the etched SiO_2 and Si surfaces.		
Course Outcomes:	Students will be able to:			
	Assessed for Student Outcomes	4-a. Evaluate impact of micro/nanotechnology innovations considering factors such as global, economic, environmental, etc. 6-a. Identify realistic constraints for photomask design based on microfabrication techniques. 6-b. Use appropriate equipment and techniques for microcscale device manufacture and characterization. 6-c. Conduct analysis and interpretation of microfabrication experimental results.		
	Other	1-a. Demonstrate knowledge of microfabrication and nanotechnology concepts. 3-a. Produce lab reports using appropriate disciplinary conventions for technical audiences. 3-b. Deliver well-organized, logical oral presentations, including good explanations when questioned. 4-b. Consider ethical and societal implications in micro/nano technology. 5-b. Share responsibilities on group works with other members of the team during labs.		
Required or Elective Course:		Elective		
Relationship of Course to Program:		Meets: Educational Objectives 1, 2, 3, 4 Student Outcomes 1, 3, 4, 5, 6		
Prepared by:		Dr. Jong-Hoon Kim	Date:	April 5, 2018 (4.9-18 mb)
Approved by USC:		4/9/2018		