

**School of Mechanical Engineering and Computer Science**  
**Mech 450/550: Micro and Nano Technology**

<b>Catalog Data:</b>	<b>Mech 450/550 Micro and Nano Technology;</b> 3 credits (2-3) 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.
<b>Class Schedule:</b>	Two 50-min lecture sessions per week, for one semester
<b>Laboratory Schedule:</b>	One three-hour lab session per week
<b>Prerequisites by Course:</b>	Chem 106, Phys 202, Mech 215
<b>Prerequisites by Topic:</b>	<ol style="list-style-type: none"> <li>1. Crystal structures</li> <li>2. Dynamic of particles</li> <li>3. Electricity, DC and AC circuits, magnetism</li> <li>4. Stress and strain</li> <li>5. Axial loads, torsion, and bending</li> </ol>
<b>Required Texts:</b>	Marc J. Madou, <i>Fundamentals of Microfabrication: The Science of Miniaturization</i> , Second Edition, CRC Press, 2002 ISBN: 978-0849308260
<b>Course Coordinator:</b>	Dr. Wei Xue
<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. Learn the principles and mechanisms of microfabrication technology</li> <li>2. Understand the bulk and surface micromachining techniques</li> <li>3. Be familiar with the essential electrical and mechanical concepts for microdevices and microsystems</li> <li>4. Understand the sensing and actuation principles for microdevices</li> <li>5. Be familiar with different sensors and actuators</li> <li>6. Obtain the fundamental knowledge MEMS</li> <li>7. Learn the concepts of nano scale materials, nanofabrication, and nanodevices</li> <li>8. Understand various measurement systems for micro/nano scale materials and device characterization</li> </ol>
<b>Topics Covered:</b>	<ol style="list-style-type: none"> <li>1. Semiconductor materials and crystal structures</li> <li>2. Introduction to microfabrication and MEMS</li> <li>3. Optical lithography and photoresist</li> <li>4. Bulk micromachining</li> <li>5. Surface micromachining</li> <li>6. Sensors and actuators</li> <li>7. MEMS CAD and simulation programs</li> <li>8. Measurement systems: scanning electron microscope (SEM) and atomic force microscope (AFM)</li> <li>9. Nano materials, nanofabrication, and nanodevices</li> <li>10. Novel micro and nano fabrication techniques</li> </ol>

<b>Lab Experiments and Activities</b>	<ol style="list-style-type: none"> <li>1. Introduction to the Device Diagnostics and Microelectronics Laboratory: lab safety policy, fabrication equipment, and measurement equipment</li> <li>2. MEMS CAD: mask design and pattern generation</li> <li>3. Lithography: transfer the structures from mask to silicon wafers</li> <li>4. Silicon dioxide etching: wet etching of SiO<sub>2</sub>, remove SiO<sub>2</sub> layers using buffered oxide etchant</li> <li>5. Silicon etching: wet etching of Si wafers, produce 3D microstructures</li> <li>6. Measurement of 3D microstructures: SEM inspection of the fabricated devices</li> <li>7. Measurement of surface profile of the microstructures; AFM inspection on the topography of the etched SiO<sub>2</sub> and Si surfaces</li> </ol>		
<b>Course Outcomes:</b>	Students will be able to:		
	<b>Assessed for Program Outcomes</b>	A-2. Demonstrate knowledge of microfabrication and nanotechnology concepts. B-2. Use appropriate equipment and techniques to characterize devices. H-3. Evaluate microfabrication techniques consider environment factors. J-1. Describe emerging technologies in micro/nano characterization.	
<b>Other</b>	B-1. Identify the constraints for photomask design and structure fabrication. B-4. Validate experimental results with respect to assumptions, constraints, and theory. C-3. Design structures that meet realistic constraints such as manufacturability and safety. C-4. Build prototypes that meet design specifications.		
<b>Required or Elective Course:</b>	Elective		
<b>Contribution to Professional Component:</b>	Engineering Topics		
<b>Relationship of Course to Program:</b>	Meets: Educational Objectives <u>1, 2, 3, 4</u> Program Outcomes <u>A, B, C, H, J</u>		
<b>Prepared by:</b>	Dr. Wei Xue	Date:	October 10, 2008
<b>Approved by CAC:</b>			