

University of Puerto Rico  
 Mayagüez Campus  
 College of Engineering  
 Department of Electrical and Computer Engineering  
 Graduate Program in Electrical Engineering

**Course Syllabus**

<b>1. General Information:</b>	
Alpha-numeric codification: INEL 6071 Course Title: Introduction to Micro-electro-mechanical systems Number of credits: 3 Contact Period: 3 hours of lecture per week	
<b>2. Course Description:</b>	
English: This course covers the basic principles of micro-electro-mechanical systems (MEMS) design, fabrication and testing. Specifically, it covers the theory behind microfabrication techniques such as pattern transfer, optical lithography, etching and design rules, material deposition techniques, lumped modeling of MEMS structures, static and dynamic behavior of MEMS and MEMS integration into systems.	
Spanish: El curso discute los principios básicos del diseño, fabricación y medición de sistemas micro-electro-mecánicos (MEMS por sus siglas en ingles). Específicamente, cubre la teoría de técnicas de microfabricación tales como transferencia de patrones, litografía óptica, remoción de capas de películas delgadas, y reglas de diseño, técnicas para la deposición de materiales, modelos de estructuras micro-electro-mecánicas, comportamiento estático y dinámico de MEMS y integración de MEMS en sistemas.	
<b>3. Pre/Co-requisites and other requirements:</b>	
Permission from the department head	
<b>4. Course Objectives:</b>	
<ul style="list-style-type: none"> <li>• Apply the theory behind microfabrication techniques such as pattern transfer, optical lithography, etching and design rules for the design of MEMS devices</li> <li>• Apply lumped modeling to MEMS structures</li> <li>• Design MEMS devices using simulation software</li> <li>• Evaluate the static and dynamic linear and nonlinear behavior of MEMS</li> </ul>	
<b>5. Instructional Strategies:</b>	
<input checked="" type="checkbox"/> conference <input checked="" type="checkbox"/> discussion <input checked="" type="checkbox"/> computation <input type="checkbox"/> laboratory  <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop  <input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input type="checkbox"/> special problems <input type="checkbox"/> tutoring  <input type="checkbox"/> research <input type="checkbox"/> other, please specify:	
<b>6. Minimum or Required Resources Available:</b>	
ANSYS and/or COMSOL software package	
<b>7. Course time frame and thematic outline</b>	
<b>Outline</b>	<b>Contact Hours</b>
1. Standard semiconductor planar processing technologies	6
2. Specific micromachining technologies	7
3. Signal/Energy Domains and modeling techniques	6
4. Micro electro-mechanical transducers (sensors & actuators)	9

5. Micro electro-mechanical-thermal transducers (sensors & actuators)	7
6. Electro-mechanical and piezoresistive transducers (sensors & actuators)	7
7. Exams	3
<b>Total hours: (equivalent to contact period)</b>	<b>45</b>

### 8. Grading System

Quantifiable (letters)  Not Quantifiable

### 9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	45
<input checked="" type="checkbox"/> Final Exam	1	25
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homework	4-5	10
<b>TOTAL:</b>		<b>100%</b>

### 10. Bibliography:

- 1) Chang Liu, *Foundations of MEMS*, Prentice Hall, 2005
- 2) Gabriel M. Rebeiz, *RF MEMS: Theory, Design, and Technology*, John Wiley & Sons, 2003
- 3) Marc J. Madou, *Fundamentals Of Microfabrication: Science Of Miniaturization*. CRC Press, 2002.
- 4) Mahamed Gad-el-Hak, *The MEMS Handbook*. CRC Press, 2005.
- 5) Nadim Maluf, Kirt Williams, *An Introduction to Microelectromechanical Systems Engineering*, Artech House Publishers, June 2004

### 11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.