This course covers wide and diverse interdisciplinary topics spanning physical, biological sciences and various engineering fields. It consists of nine integrated labs by which students can acquire hands-on experience in various aspects of nano and micro science and engineering. The course addresses microfabrication, microfluidics, nanomechanics, as well as analytical methodologies, computational tools, and experimental techniques to evaluate micro/nano systems.

### Course Schedule (Lab Projects):

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Week #</th>
<th>Lab Title</th>
<th>Teaching Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Lithography and Fabrication of PDMS Microchannels (Design of Photomask Using L-Edit)</td>
<td>Carmen Hernandez and Keun-Ho Kim (<a href="mailto:c-hernandez@northwestern.edu">c-hernandez@northwestern.edu</a>)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Microchannel Transport Properties Using Fluorescent Beads</td>
<td>Keun-Ho Kim (<a href="mailto:kkim@northwestern.edu">kkim@northwestern.edu</a>)</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>Introduction to AFM and Dip-Pen Nanolithography</td>
<td>Changhong Ke (<a href="mailto:c-ke@northwestern.edu">c-ke@northwestern.edu</a>)</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Design of RF MEMS Switches Using ANSYS Multiphysics</td>
<td>Yong Zhu (<a href="mailto:yzhu@northwestern.edu">yzhu@northwestern.edu</a>)</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>Actuation of RF MEMS Switches; time response, signal characteristics</td>
<td>Yong Zhu</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Nanoindentation of Quartz, Aluminum Single Crystals and Diamond Thin Films</td>
<td>Francois Barthelat (<a href="mailto:f-barthelat@northwestern.edu">f-barthelat@northwestern.edu</a>)</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>Assessing the Characteristics of Surface and Bulk Micromachined Accelerometers</td>
<td>Mike Moldovan (<a href="mailto:n-moldovan@northwestern.edu">n-moldovan@northwestern.edu</a>)</td>
</tr>
<tr>
<td>FP1</td>
<td>9-10</td>
<td>Manipulation of Microbeads Using DC/AC Electrical Fields</td>
<td>Changhong Ke</td>
</tr>
<tr>
<td>FP2</td>
<td>9-10</td>
<td>Testing of MEMS Materials Using Thermal Actuation, AFM image Correlation and Capacitance Measurements</td>
<td>Yong Zhu</td>
</tr>
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</table>

FP: Final Project
Grading: Final course grade will be based on the following distribution.
Lab participation and reports 70 %  
Final Project 30 %

Submissions: Reports submitted only in class.

Late submission: 20%/day deduction from the full score

References:

Access to University Facilities:
Each student will need to make arrangements to gain access to the MRC Clean room and the electron microscopy facility, EPIC. You should schedule in the first week of classes training at MRC for spinner, photolithographic equipment and reactive ion etcher. In the second week of classes, you should schedule AFM training in EPIC. These facilities have a nominal charge. Please obtain from your advisor an account number.

Points of Contact
MRC General safety training: Kipyung Ahn, kpahn@northwestern.edu; Lithography: Zach Homrighaus, z-homrighaus@northwestern.edu; RIE: David Towner, d-towner@northwestern.edu

EPIC SEM: Ben Meyers, b-myers3@northwestern.edu; AFM: Gajendra Shekhawat, g-shekhawat@northwestern.edu

General Guidelines:
- Each student will need to write and turn in his/her individual report. You are encouraged to work together and discuss lab problems but make sure that the work you turn in is your own.
- Late reports will be deducted at the rate of 20% per day late. Maximum grace period is until graded report is returned.
- Instructor reserves the right to raise the final grade of any student by one letter based on participation in class and laboratory sessions.
- Attendance to class and labs is required. If you cannot come please let the teaching assistance know in advance. You should just send e-mail.
- Feel free to meet me in my office to discuss homework, labs or other issues at any time. You may want to call before coming to see me to assure that I do not have a meeting coming up.