Course Syllabus

Instructor: Prof. Sarah Bergbreiter
Email: sarahb@umd.edu (best means of contact)
Office: 2170 Martin Hall
Office hours: Tuesdays 11-1pm or by appointment

Lecture: TTh 9:30-10:45am, EGR 2116
Website: Blackboard https://bb.eng.umd.edu
Prerequisites: ENME351 or equivalent. It is preferred, but not required that the student have some background in MEMS, robotics, or nanotech.

Course Description
This course will cover design, modeling, fabrication, and analysis of robots operating on the “micro” and “nano” scale. Micro/nano robots are defined in a variety of different ways but in general a microrobot will have features on the micron scale or make use of micro-scale physics for manipulation or mobility. Topics covered will include the physics of scaling, fabrication, actuation and sensing, and case studies of micro/nano robots.

Semester Schedule (Tentative)

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<tr>
<th>Week #</th>
<th>Week of</th>
<th>Topics</th>
<th>Project</th>
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| 1 | Sept 1 | Introduction (overview + examples)  
Physics of scaling | |
| 2 | Sept 8 | Physics of scaling  
MEMS/NEMS fabrication for robotics | |
| 3 | Sept 15 | MEMS/NEMS fabrication for robotics  
SCM, Polymer microsystems, Other fab | |
| 4 | Sept 22 | Assembly for 3-D Fabrication  
Mechanisms and flexures | |
| 5 | Sept 29 | Actuation – electrostatic, DEA  
Actuation – thermal, SMA | Project topic ideas due Oct. 2 |
| 6 | Oct 6 | Actuation – piezoelectric  
Actuation – magnetic | |
| 7 | Oct 13 | Sensing – strain, capacitance  
**Guest Lecture: Jeff Pulskamp from ARL** | |
| 8 | Oct 20 | Sensing – microscopy  
Sensing – noise | Project proposal due Oct. 23 |
| 9 | Oct 27 | **Guest Lecture: Jason Gorman from NIST**  
Case Study: Bio-inspired sensors | |
| 10 | Nov 3 | Simulation and Layout tools  
Power – batteries, solar | |
| 11 | Nov 10 | Power – energy harvesting  
Power – external fields | |
| 12 | Nov 17 | Locomotion on land  
Locomotion in fluids | Project mid-term report due Nov. 20 |
| 13 | Nov 24 | Communication  
Thanksgiving Holiday | |
| 14 | Dec 1 | Networked robots and swarms  
Case Study: Mobile Microrobots | |
| 15 | Dec 8 | Project Presentations | Project paper due Dec. 13 |
| TBD | | **Final Exam** | |
Textbook
There is no required textbook for this class. However, several books have been placed on reserve at the Engineering Library and journal/conference papers will be assigned each week as required reading.

Grading
Homework: 25%
Paper Reviews: 15%
Project: 40% (Proposal + Midterm Report 10%, Final Paper 20%, Final Presentation 10%)
Final Exam: 20%

Homework
Assignments will be posted on Blackboard and will be due on the date and time stated (usually every 2 weeks). Late homework will be accepted with the caveat that 10% will be taken for each day late. If you will be unable to submit a homework assignment on time, you need to let me know *before* the homework due date. Some of the homework may require separate scheduling to visit the lab and play with microfabricated chips. Graduate students will be assigned an extra question or two on the homework that undergraduates are welcome to attempt, but it is not required.

Paper Reviews
Papers relevant to the following week’s topic will be assigned on Blackboard for reading each Tuesday. Each student will choose at least one of these papers and write a 1-2 paragraph review due by midnight on the following Tuesday. This review is not a book report – I am primarily interested in your interpretation of the paper.

Project
As evident from the grading, this class will place heavy emphasis on projects. Project teams of two students are preferred to work on a project topic that will be decided early in the semester. This topic can be related to any aspect of a micro/nano robot, although a limited subset of fabrication processes will be available for use. Teams will start by emailing their project topic and a short description. After some discussion, the students will do a literature review to study their topic of interest and determine the interesting avenues of research involved in this particular topic. This literature search (and bibliography) along with a work plan for the rest of the semester will be due October 23, 2014. A short report (2-3 pages) including motivation, objectives, and expected results (empty plots and figures) will be due November 20, 2014.

Final reports should be formatted in IEEE conference format (min 4, max 6 pages) as would be required for submission to a major robotics or MEMS conference – ICRA, IROS, Transducers, MEMS, etc. These reports will be due December 13, 2014. Project presentations (~10 minutes per team) will be held during the final week of classes. It is expected that outstanding project reports will lead to future conference and journal publications.

Final Exam
The final exam will test some of the more fundamental principles discussed in lecture. It will be open notes. The assigned final exam slot is TBD.

Lecture Notes
I will do my best to post lecture notes on Blackboard during or after the week of lecture. These notes are intended to help you understand the material and are not a substitute for attending lecture.

Academic Integrity
I encourage you to discuss homework assignments. However, you will be cheating if you turn in anybody
else’s work (homework, project report, exam answers, schematics, figures, etc) but your own. I realize that this will not apply to the large majority of students in this class, but past experience has taught me that a few will still be academically dishonest. If I catch you cheating, I will give you a 0 on the assignment and refer you to the Office of Student Conduct. Facilitating cheating is the same thing. The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.she.umd.edu.

Course Evaluations
Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process.