Summer Course Announcement, Application Instructions, and Course Syllabi

We are writing to announce two new one week summer courses: “Modern Optical Microscopy” and “Introduction to Microfluidics Technology” to be held at Brandeis University, near Boston, MA. Both courses are hands-on laboratory courses, sponsored by the Materials Research Science and Engineering Center (MRSEC) at Brandeis. The optics course will be offered in the week of June 20 - 24, 2011 and the microfluidics course in the week of June 27 – July 1, 2011. These courses are intended for graduate students, usually early in their research career, in both physical sciences and life sciences, and do not assume any specific prerequisites.

“Modern Optical Microscopy” (June 20 - 24, 2011) will be taught by Professor Zvonimir Dogic of the Physics department at Brandeis. It is based on a very successful one semester graduate course on the same topic.

“Introduction to Microfluidics Technology” (June 27 – July 1, 2011) will be taught by Dr. Dongshin Kim, who heads the MRSEC microfluidics laboratory at Brandeis, and is based on his extensive experience in both research and teaching of this subject to students of all levels of preparation and many fields of research.

Please see the other documents further down on this page for detailed course descriptions. Other information will be added later.

There is no tuition fee for these courses. A fixed fee of $300 covers housing and on site breakfast, lunch, and snacks during breaks, for Monday through Friday of each course. For local students not needing housing, the fee for food only is $175.

We ask that you bring these courses to the attention of appropriate graduate students, and ask them to apply for either one or both, following the application instructions below.

Application Instructions: To apply, please email Geoff Svacha, svacha@brandeis.edu, preferably by April 30, 2011, with:

* Name and gender (for housing)
* If admitted, will you need housing (we need to plan as soon as possible)?
* Affiliation (your grad school and department), and your undergraduate school
* College major
* Year you entered grad school
* Graduate classes taken or currently enrolled in
* Field of research
* Research advisor (who must write a letter of recommendation for you)
* List of publications (published, submitted, in preparation) with title and authors
* A short paragraph telling how your research work will benefit from the course (or courses) you are applying for
* In addition, please have your research advisor write a letter to the same email address in support of your application.

Applications will be reviewed on a rolling basis, and suitable students will be admitted as we select them, throughout the month of April. Further information for those admitted will be provided in due time, including requests for further information, such as special needs, travel plans, and any other individual information that may be relevant. If you have questions before applying, please address them to Dr. Svacha at the address given.

**MRSEC Summer Course in Modern Optical Microscopy**

**Instructor:** Professor Zvonimir Dogic

**Email:** zdogic@brandeis.edu

Modern optical microscopes have become powerful experimental tools capable of simultaneously visualizing large scale structures such as entire cells, and fluorescently labeled single molecules within these complex structures. They have found important applications in diverse scientific fields ranging anywhere from psychology and neuroscience to physics and cell biology. The primary goal of this summer school course is to train students in the fundamentals of microscopy optics. Our goal is to make the optics course accessible to students with all scientific backgrounds.

The week-long course will be organized around three laboratory exercises, each taking about 10-12 hours to complete.

*In the first of these, students construct simple benchtop optical setups to demonstrate fundamental principles of optics including geometrical optics, optical aberrations, Fourier optics and spatial filtering. This lab concludes with construction of a simple benchtop bright field microscope with Kohler illumination.*

*The second laboratory exercise is focused on development of an epi-fluorescence/TIRF microscope on an optical bench. At this point students have gained sufficient knowledge to critically evaluate the performance of research grade microscopes and associated CCD cameras.*

*The final laboratory will involve working with research grade bright field and fluorescence microscopes. Amongst other exercises, students learn how to measure the modulation transfer function of an optical system and determine how it depends on the numerical aperture of the microscope’s objective lens and condenser optics.*
MRSEC Summer Course in Microfluidics Technology

Instructor: Dongshin Kim

Email: dongshin@brandeis.edu

Course Objectives:
This course is an introduction to the microfabrication technologies available to build microfluidic devices. This course has been created in response to the great interest from industry, government and academia in the field of microfluidics. We will build several microfluidic devices to understand the microscale phenomena and their applications. Throughout the course, we will place an emphasis on hands-on experimentation with microfluidic systems where laminar flow, surface tension, and molecular diffusion dominate.

Prerequisites:
To get the most out of this course, it will help if you have some familiarity with basic conservation equations of mass, momentum, and heat, and classical thermodynamics. Some chemistry laboratory experience is recommended but not required. However, students are required to take the online environmental health and safety trainings offered by the Boston Consortium (http://www.boston-consortium.org/professional_development/environmental_health_safety_training.asp) before the second day of this course.

Course Outline and Schedule

1. Overview of microfluidics (Day 1)
   a. Course introduction (1 hr)
   b. Introduction of microfluidics with basic theory (2 hrs)
   c. Introduction of microfabrication technologies (2 hrs)
      i. Photomask design
      ii. Liquid phase photo-polymerization
      iii. Soft lithography
      iv. Glass chips
      v. Hot embossing
   d. Photomask design using AutoCAD (2 hrs)

2. Fabrication 1 – Liquid phase photo-polymerization (Day 2)
a. Fabrication (2 hrs) (the designed photo mask will be printed using a regular office laser printer at this time)
b. Laminar flow and diffusion experiment (2 hrs)
c. Hydrogel actuator fabrication and swelling experiment (3 hrs) (using the instructor’s photomasks)

3. Fabrication 2 – Soft lithography I (Day 3)
   a. Basic training on cleanroom (1 hr)
   b. Training of master fabrication using both positive and negative photoresists (4 hr)
   c. Training of PDMS molding (2 hr)

4. Fabrication 3 – Soft lithography II (Day 4)
   a. Fabrication on their own (7 hrs) (students will be provided with readymade photomasks)

5. Microfluidics experiment (Day 5)
   a. Droplet formation and crystallization (2 hrs)
   b. Peristaltic pumping (2 hrs)
   c. Concentration gradient generation based on both static and flow methods. (2 hrs) (gradient will be analyzed using fluorescence microscopy and image analysis software)
   d. Wrapping up (1 hr)