

# **QBIO 120b: Quantitative Biology Instrumentation Laboratory Spring 2019**

**Instructor:** Seth Fraden (fraden@brandeis.edu)

## **Course description**

This course aims to provide an understanding of modern instruments used in biological research with special emphasis on brightfield and fluorescence microscopes, spectrophotometers, and fluorimeters. The approach is a practical one geared to students who are or will be using these instruments in research. The course consists of six two-week long lab projects. In the initial projects, students assemble optical instruments from their component parts and quantitatively characterize the performance of the instruments. In the later projects, students apply the understanding gained in the initial projects to getting the optimal performance out of commercial microscopes and fluorimeters and avoiding pitfalls in their use. The course also covers basic aspects of biological and biochemical sample preparation.

The six projects are:

- Geometrical optics and microscopes
- Fourier optics and imaging performance
- Brightfield and phase contrast microscopy
- Fluorescence spectroscopy
- Absorption spectroscopy
- Fluorescence microscopy including live cell imaging

Usually, students work on projects in pairs. We try to pair students with complimentary academic backgrounds in order to enhance the learning experience. For example, a life sciences Ph.D. student familiar with biological sample preparation might be paired with a physics student familiar with optics, so that the students can learn from each other as well as from the instructor.

**Target audience** The course is designed for life sciences and physical sciences Ph.D. students. It is specifically designed to accommodate the different academic backgrounds of the students enrolled in the different programs. The course is also appropriate for advanced undergraduate students who have sufficient laboratory training. Undergraduates should (and Ph.D. students may) consult the instructor to check that they have adequate preparation for the course.

**Meeting place and times** The course meets *only 6 hours per week*: Mondays 1– 3:50 pm and Fridays 1:30 – 4:20 pm. The course is held in the Biology (Bassine) Building Room 244.

### **Organizational meeting**

The first course meeting will take place Friday January 18, 2019 at 1:30 pm.

### **Schedule notes**

For the full lab schedule, and lab report due dates please consult “Schedule” document posted on the Latte website.

### **Written work**

Each student individually completes a written report on each of the six lab projects. A report focuses on a single aspect of the project (selected by the student), and gives background, reports data, and presents conclusions based on the data. Grading is based roughly 70% on lab reports and 30% on lab participation. There are no written examinations.

### **Reading**

Readings for the course consist of lab descriptions plus supplemental readings taken from a variety of sources including the following:

1. Sears and Zemansky, (chapters on geometrical optics and diffraction), University Physics (Addison-Wesley)
2. Eugene Hecht, *Optics* (Addison-Wesley, 2001)
3. Shinya Inoue and Kenneth R. Spring, *Video Microscopy*, (Plenum Press, 1997)
4. Microscopy web sites <http://www.microscopyu.com> and [www.olympusmicro.com](http://www.olympusmicro.com)
5. *Optics of Life*, Sonke Johnsen, Princeton University Press, 2011 [A very intuitive book, you can read it before bed; it is the most digestible guide to optics that I have read.]

As many of the readings as possible will be posted on the course LATTE web site. Students not yet registered for the course can contact the instructor for guest access.

### **Instructor consultation**

I am available to work with students during all scheduled lab hours also by appointment (my office is Abelson (physics 214). Seth Fraden ([fraden@brandeis.edu](mailto:fraden@brandeis.edu)))

### **TA info**

Consultation by appointment: Felix Zhou ([fyz2@brandeis.edu](mailto:fyz2@brandeis.edu))

### **Effort statement:**

Success in this 4 credit hour course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, papers, discussion sections, preparation for exams, etc.).