Description: This course is intended for entering PMCB students interested in quantitative bioscience approaches to biomedical research and second year students of all programs interested in a deeper understanding of the technologies that they use. The course will examine the physical principles underlying the instrument design and function.

Lectures: 1.5 hr; MW, Location: TBD; Discussion: 1hr, time & location TBD.

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Sept 29th</td>
<td>Introduction</td>
<td>Principles of measurement science – from invention to commercial deployment</td>
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<tr>
<td>Oct 1st</td>
<td>Light Microscopy</td>
<td>Physics of light microscopy</td>
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<td>Oct 6th</td>
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<td>Optical coherence tomography</td>
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<td>Oct 8th</td>
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<td>Super-resolution microscopy and 3D reconstruction</td>
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<td>Oct 13th</td>
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<td>Contrast chemistry (fluorescence, photoswitchable dyes, etc)</td>
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<tr>
<td>Oct 15th</td>
<td>Electron Microscopy</td>
<td>Physics of electron microscopy</td>
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<td>Oct 20th</td>
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<td>Modern electron microscope survey</td>
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<td>Oct 22th</td>
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<td>Linking crystallography and EM; High resolution 3D tomography</td>
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<td>Oct 27th</td>
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<td>Sample preparation issues (contrast generation, cryopreservation, ultra thin sectioning, …)</td>
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<td>Oct 29th</td>
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<td>Mid-term Exam</td>
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<tr>
<td>Nov 3rd</td>
<td>Anatomic Imaging</td>
<td>The physics and mathematics of MRI</td>
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<td>Nov 5th</td>
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<td>Survey of modern MRI instruments</td>
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<td>Nov 10th</td>
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<td>The physics of PET imaging – radioisotopes, scintillators, coincidence electronics</td>
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<td>Nov 12th</td>
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<td>Cyclotrons, radioisotope generation and radiochemistry</td>
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<td>Nov 17th</td>
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<td>Physics of CT imaging including exposure levels and 3D reconstruction</td>
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<td>Nov 19th</td>
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<td>Multimodality image reconstruction, display and quantitative interpretation</td>
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<td>Nov 24th</td>
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<td>MRI – measurement reconstruction</td>
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<td>Nov 26th</td>
<td>Parallel Sequencing</td>
<td>Contrasting capillary and massively parallel sequencing approaches</td>
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<tr>
<td>Dec 1st</td>
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<td>Nanovolume chemistry and fluidics</td>
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<tr>
<td>Dec 3rd</td>
<td></td>
<td>Survey of modern and coming generation sequencers</td>
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<td>Dec 8th</td>
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<td>Personal experiences with technology development – pick one from flow cytometry and sorting, BrdUrd/DNA analysis, FISH, CGH , etc.</td>
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<tr>
<td>Dec 10th</td>
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<td>Final Exam</td>
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Course Director: Monica Hinds, PhD  
Associate Professor of Biomedical Engineering, OHSU  
Email: hindsm@ohsu.edu  
Phone: 503 418-9309  
Office – 13036 CHH, 3303 SW Bond Ave, OHSU  
Office hours: There will not be formal office hours for this class, but students can setup appointments with the instructor via email.

Co-Director: Xiaolin Nan, PhD  
Assistant Professor of Biomedical Engineering, OHSU  
Email: nan@ohsu.edu  
Phone: 503 418-9317  
Office – 13036 CHH, 3303 SW Bond Ave, OHSU

Potential Lecturers (*confirmed interest):

<table>
<thead>
<tr>
<th>General Topic</th>
<th>Potential Lecturers</th>
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</table>
| Light Microscopy               | Dr. Monica Hinds*  
Dr. Xiaolin Nan*  
Dr. Steve Jacques  
Dr. Summer Gibbs  
Dr. Kim Beatty  
Dr. Tania Vu |
| Electron Microscopy            | Dr. Erik Barklis  
Dr. Michael Chapman  
Gareau  
Chris Arthur  
Lopez  
Hai-ning |
| Anatomic Imaging-MRI           | Dr. Bill Rooney*  
Dr. Charlie Springer  
Dr. Chris Kroenke  
Dr. Mark Woods  
Dr. Tom Barbra |
| Anatomic Imaging- CT and PET   | Dr. Bill Rooney*  
Dr. Fergus Coakley |
| Parallel Sequencing            | Dr. Joe Gray*  
Dr. Paul Spellman*  
Dr. Bob Searles  
Dr. Chris Corliss  
Dr. Jeff Tyner |
Learning Objectives:

Upon completion of the course, students are expected to be able to:

1. Understand the physics, chemistry and fluidics behind optical, EM and anatomic imaging as well as massively parallel sequencing.
2. Describe the component of each measurement technology and the contribution of each component to the final output.
3. Describe the strengths and weaknesses of each measurement technology.
4. Describe the applications of each measurement technology.
5. Critically analyze the output of each measurement technology.
6. Describe the limitations of the output of each measurement technology.
7. Explain how each measurement technology could be improved.
8. Understand how to position new measurement technologies so they can be transferred to the private sector for commercial development.

Registered Students’ Pre-Requirements:

1. Optics: either as a stand-alone undergraduate course or a substantial segment of a general physics course. (Instructors can advise.)

Registered Students’ Requirements:

1. Attendance > 80%.
2. Complete assigned reading prior to class.
3. Participate in discussions of journal articles.
4. Perform satisfactorily on exams.

Grading: The grading system has been designed to emphasize comprehension of course topics.

10% of the grade – Lecture attendance & Discussion participation: Each week, the instructor will upload a research paper relevant to the week’s lectures. To ensure a thorough understanding of the topics covered, students will be required to participate in discussions of presented journal articles.

20% of the grade: write an executive summary (background, hypothesis, aims; ½ page, single spaced, 11 point Arial font, ½ inch margins) for a proposal that would have funded the work in the week’s featured paper. Summaries will be graded on the NIH scale of 1-10, and will be returned to you each week. Executive summaries will be due by email at the start of each lecture, in order to ensure your participation and knowledge of the material of the topics that are being presented. Scoring: 1-2 = A; 3-4 = A-; 5-6 = B+; 7-8 = B; 9-10 = B-; 11+ = C

30% of the grade – Midterm exam: Students will be examined on the Light and EM microscopy lectures.

40% of the grade – Final exam: Students will be examined on the Anatomical imaging and Massively Parallel Sequencing lectures.
This course will use an A-F grading scale. Evaluations of exam questions will be done by lecturers. Evaluation of class participation will be done by the course directors.

**Reading:** Assigned readings (research papers
Reference books will be made available in the library: