San José State University
Department of Physics and Astronomy
Physics 120C: Advanced Physics Lab: Optical Microscopy, contrast methods, and digital imaging, Spring 2018

Course and Contact Information

Instructor: Neil Switz
Office Location: Sci 310
Telephone: 408-924-5252
Email: neil.switz@sjsu.edu (email is the best way to reach me!)
Office Hours: Tuesdays 4:30 – 5:30PM; Wednesdays 1:30 – 2:30PM in Science 310, or by appointment.
Class Days/Time: Mondays 12:30 – 4:20pm; and Wednesdays 12:30 – 1:20 PM
Classroom: Sci 242 (Monday, Wednesday 12:30 – 1:20); Sci 39 (Mondays 1:30 – 4:20)
Prerequisites: PHYS 52, 120A and PHYS 158 all with grade of "C-" or better.

GE/SJSU Studies Category:

Faculty Web Page
Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas Leaning Management System course login website (for Sec 01; do not confuse with Sec 11, which we will not use. Accessible via MySJSU at http://my.sjsu.edu). You are responsible for regularly checking with the messaging system through Canvas to learn of any updates, assignments, or announcements.

Course Description
Design of optical microscope systems involving standard optomechanical components. Use of optical systems to explore the Abbe theory of image formation, contrast methods including phase contrast and fluorescence, and digital imaging.

Course Learning Outcomes (CLO)

Upon successful completion of this course,
1. students will have reinforced their knowledge of basic physics principles, particularly in optics
2. In addition, students will have experience applying their knowledge to practical, theoretical and experimental problems, including:
   a. developing experiments that decisively test a hypothesis
   b. analyzing experimental results and drawing reasonable conclusions from them
   c. interpreting experimental data to draw meaningful conclusions from properly conducted experiments
3. Students will also have preparation for careers in science, industry and education, particularly in the sense of being able to:
   a. identify and use standard laboratory equipment and instrumentation
   b. apply critical thinking skills to solving problems in physics
Required Texts/Readings

Textbook
- Course Reader (provided)
- Online vendor resources (White Papers, Technical Notes, etc.; all available free)

Other technology requirements / equipment / material
Access to a computer (Mac or PC) will be necessary for writing lab reports and analyzing data.

Course Requirements and Assignments
The course will require weekly multi-page written lab reports. These serve to reinforce the concepts in the reading, provide you practice with doing actual calculations, and model some problems that will appear on exams. Exams serve to assess your understanding, as well as provide opportunities for you to review and reinforce knowledge you have gained.

The University’s Credit Hour Requirement is as follows:
“Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.”

⇒ This means that you will need to spend 6 hours per week doing reading and assignments for this course if you are appropriately prepared coming in. If you must review material from prerequisite classes, that workload will increase. Lab work and class time is in addition to this.

The best approach to the homework (and course) is to:

- Read the relevant part of the material before class and lab: note where things are confusing so you can pay extra attention to that (or ask about it) in lecture. Being prepared for lab is the difference between understanding and enjoying the class and flailing about.

- Go back and work through problems that are done in lecture, and exercises done in lab. Note the approach used to understand the problem.
  - Hint: exam problems are often drawn from such examples…

- Do a careful lab write-up. If you do these attentively, paying attention to the theory, exam performance will follow.

Assignments
Labs: The weekly labs are the heart of the course, giving you hands-on experience with technical equipment and the chance to use your physics knowledge in the context of immediate technical problems in the lab. These are especially valuable skills, and emphasis is thus placed heavily on engagement with lab, working productively with lab-mates, and review and interpretation of lab results (see below).

Absences from lab, except in extenuating circumstances (see University policy, below), are not permitted. You may have one absence from lab – only with adequate explanatory circumstances, and you must still do the lab and turn in the lab report – and not have it count against your grade. A second missed lab is grounds for a WU in the course. You must meet with your instructor to figure out how to proceed if you miss a second lab. It may be excusable depending on the nature of your absence (e.g. for documented medical reasons) and your
performance in the course to date, but still must be completed. Missing three labs will result in a WU in the course, no exceptions.

Lab reports: There will be weekly (sometimes biweekly) written lab reports. These prepare you for the sort of work required in a PhD program or industrial job, as well as reinforce the concepts being presented. They are a major component of the grade.

Exams: there will be one midterm exam (which may include a practical, hands-on component). These serve as opportunities to review and reinforce knowledge you have gained earlier in the course.

**Final Examination or Evaluation**

The Final Examination is as listed in the Class Schedule.

- The Final Exam period may be used for project/report presentations. Keep the time block free. The exam will be either a standard examination or a culminating experience involving an aspect of modern microscopy.

Additional details of examination schedule are available at [http://info.sjsu.edu/static/schedules/final-exam-schedule-fall.html](http://info.sjsu.edu/static/schedules/final-exam-schedule-fall.html), and the entirety is governed by University Policy S06-4 ([http://www.sjsu.edu/senate/docs/S06-4.pdf](http://www.sjsu.edu/senate/docs/S06-4.pdf)) which states that

    "There shall be an appropriate final examination or evaluation at the scheduled time in every course, unless specifically exempted by the college dean who has curricular responsibility for the course."

**Grading Information**

Homework: There will be weekly lab reports due, which collectively are worth a large fraction of the grade.

Quizzes: There will be weekly quizzes to assure you are doing the reading and prepared for lab. Failing the reading quiz may result in your not being allowed to use the lab equipment that day; see above for consequences of missing a lab.

Lab: Lab is mandatory, and the major component of this course.

Exams: There will be one midterm exam; see Class Schedule for dates.

Participation: Attendance in lab is mandatory; attendance in lecture is advised, and more than one lab absence will be unfair to the student’s lab partner and thus allowed only in extenuating circumstances (medical emergency, etc.)

**Determination of Grades**

Grading will be based on a score weighted as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Weighted %age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab reports</td>
<td>45%</td>
</tr>
<tr>
<td>Lab participation, including Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
</tr>
<tr>
<td>Final</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

The final grading allocation will be: A range: 90+ curved score; B range: 80+; C range: 70+, D range: 60+; F: less than 60.
Classroom Protocol

The intent of classroom protocol is to make the environment conducive to learning for the whole class. In many ways this boils down to respect. Beyond the student code of conduct, but in keeping with it, respect is required in class: harassment, disruption, and distracting others is not acceptable. This extends to:

- Cell-phones: Ringers off, stowed during class. If you must be on your phone, do not come to class (though you may then miss in-class assignments.)
- Computers: stowed during class. Exception: if you are taking notes. Websurfing/email is not allowed. This is simple courtesy to your fellow students: having someone websurfing in front of you is distracting.
- Illness: if you have a cold/flu, or feel that you are getting one, do not come to class. If you are clearly sick during class, you may be asked to leave. Even on an exam day, if you are truly ill please stay home. Email the faculty – before class – however, so that we know why you are absent.
- Recordings: Recording (audio, pictures, or video) of class, class members, or faculty and staff without permission are a violation of privacy, and not permitted. Unpermitted recording may result in your being asked to leave. Make a request and receive permission before taking pictures, etc. See the University Policies link below (pictures of the blackboard, though, are fine as long as they don’t contain people).
- Participation: participation is encouraged; belittling anyone for asking a legitimate question will result in negative participation score, possible removal from class, and, if conduct is egregious, referral for a Student Conduct Code violation.
- No pets. (Officially trained Service dogs for disabilities are fine.)

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs’ Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/
Phys 120C Advanced Physics Lab: Optics and Lasers, Spring 2018
Mon 12:30-4:20p; Wed 12:30 – 1:20p

The schedule for the semester follows; it is subject to change. Any change will occur with fair (at least one week’s) notice, and such notice will be made in class and posted as on the course Canvas website.

**Course Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics, Readings, Assignments, Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wed, Jan 24</td>
<td>Introduction; review of basic optical imaging.</td>
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<tr>
<td>2</td>
<td>Mon, Jan 29</td>
<td>Review of optical imaging; introduction to optomechanics</td>
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<tr>
<td>3</td>
<td>Mon, Feb 5</td>
<td>Lab 1: Introduction to Optical Imaging, I: equipment, cameras, lenses, spectra.</td>
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<tr>
<td>4</td>
<td>Mon, Feb 12</td>
<td>Lab 2: Introduction to Optical Imaging, II: imaging with a camera; rail system.</td>
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<td>5</td>
<td>Mon, Feb 19</td>
<td>Lab 3: Aberrations and illumination: lens orientation; coherence; achromatism</td>
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<td>6</td>
<td>Mon, Feb 26</td>
<td>Lab 4: Kohler Illumination</td>
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<tr>
<td>7</td>
<td>Mon, Mar 5</td>
<td>Lab 5: Kohler, Conjugate Planes, and Dark-field Imaging</td>
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<td>8</td>
<td>Mon, Mar 12</td>
<td>Review &amp; Midterm. Includes practical.</td>
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<td>9</td>
<td>Mon, Mar 19</td>
<td>Lab 6: The Abbe Theory of Image Formation, I: Spatial filtering</td>
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<td>10</td>
<td>Mon, Mar 26</td>
<td>Spring Break</td>
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<tr>
<td>11</td>
<td>Mon, Apr 2</td>
<td>Lab 7: The Abbe Theory of Image Formation, II: MTF (coherent, incoherent)</td>
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<tr>
<td>12</td>
<td>Mon, Apr 9</td>
<td>Lab 8: Contrast methods (phase contrast; darkfield)</td>
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<td>13</td>
<td>Mon, Apr 16</td>
<td>Lab 9: Fluorescence imaging</td>
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<td>14</td>
<td>Mon, Apr 23</td>
<td>Lab 10: Spectra &amp; photon budgets</td>
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<td>15</td>
<td>Mon, Apr 30</td>
<td>Photon budget exercise (in-class)</td>
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<tr>
<td>16</td>
<td>Mon, May 7</td>
<td>Lab 11: Polarization microscopy</td>
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<tr>
<td>17</td>
<td>Mon, May 14</td>
<td><strong>Final Examination during normal Monday class time. Includes practical.</strong></td>
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<td>Separate Final culminating experience is on Friday, May 18th, from 12:15 – 2:30PM in Sci 242 (the regular classroom; we may also use Sci 41).</td>
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