Physics 3410/6750 - Sections 002-003 (Foundations of Modern Optics Lab Portion)  
Fall 2019  
Tuesdays (Section 002), Wednesdays (Section 003) at 2pm-6pm  
in the Physics Building (Building 10) room 305

Instructor:  Gernot Laicher  
Email: gernot@physics.utah.edu  
Phone Number: 801-585-5553  
Office Hours: M 3m-4pm, F 1pm-2pm (check Canvas for potential changes) or by appointment  
Office Location: Physics Building room 410 (Building 10)  
Email communication preferred.  
Text messages can be sent to 801-410-0725

Required Materials  

Course Description  
Physics 3410/6750 is a lecture and laboratory course that teaches theoretically and in a laboratory basic to advanced principles of optics. Lecture occurs twice per week (Section 001) and each laboratory section meets once per week (Sections 002-003).

Course Outcomes (Lab Portion)  
By the end of this course, you will be able to:  
- Describe mathematically light reflection and refraction at plane surfaces, spherical interfaces, thin and thick lenses.  
- Build a basic telescope, microscope, and beam expander and predict and understand the magnification properties of these instruments.  
- Explain what depth of field means and how it is affected by apertures.  
- Perform a Foucault knife test on a spherical lens and describe how the knife test informs us about spherical aberration.  
- Use auto-collimation and lens equations to determine focal lengths of lenses.  
- Describe the mechanisms causing and changing the polarization of light, such as dichroic absorption, polarization by reflection, birefringence, optical retardation, and optical activity.  
- Mathematically describe and practically use interference phenomena such as Young’s double slit experiment, interference by plane parallel plates.  
- Mathematically describe and practically use high precision interferometers such as a Fabry-Perot and Michelson interferometer both with manual and electronic fringe counting.  
- Practically use and mathematically describe interference by periodic and non-periodic structures such as in transmission and reflection gratings.
• Practically apply Fabry-Perot and Michelson interferometers for high resolution spectrometry, measurement of the index of refraction of a gas as a function of pressure, and thickness measurements of transparent materials.
• Assess measurement uncertainty and propagate errors.
• Write succinct reports describing your experiment work in the course.

Teaching and Learning Methods
The laboratory part of Physics 3410/6750 is intended as a practical extension to the lecture part of this class. The topics in the laboratory are therefore closely related to the topics treated in the lecture. This laboratory assumes very little prior experience with optics, starts out at an elementary level but quickly evolves into more advanced topics. The laboratory activities will be performed by individual students, while still allowing generous interaction between students. Collective learning and collaborative discussion between students and instructor are encouraged. For each lab activity, a report will be submitted in which basic description of the activity, data presentation, evaluation, and analysis are presented.

Grading:
Physics 3410/6750 are graded courses with letter grades A, B, C, D, or E assigned at the end of the course.
For the LABORATORY PORTION of Physics 3410 and 6750 there are 9 lab reports due. Seven lab reports are condensed lab reports and receive 10 points maximum. Two lab reports are more extensive and receive 15 pts maximum each. The maximum number of pts achievable is therefore 100pts.
There is no separate laboratory letter grade assigned at the end of the semester. Instead, the laboratory performance will be included in the final grade assigned for Physics 3410/6750. Typically, the laboratory portion contributes 50% to the final grade, while the other 50% are from the lecture portion of the course, which is typically computed from homework scores as well as midterm and final exam scores.

University Policies
1. The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

2. University Safety Statement. “The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message.
3. **Addressing Sexual Misconduct.** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

4. **Diversity / Inclusivity Statement.** It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you. (Source: University of Iowa College of Education)

5. **Undocumented Student Support Statement.** Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

6. **Student Code and Accommodation Policy:**
   a. Student Code: [http://regulations.utah.edu.academics/6-400.php](http://regulations.utah.edu.academics/6-400.php)
   b. Accommodation Policy (see Section Q): [http://regulations.utah.edu.academics/6-100.php](http://regulations.utah.edu.academics/6-100.php)
Course Policies

**Due Dates:** Lab reports are due 1 week after the lab activity was completed - unless the week after a lab falls on Fall break in which case an extra week is granted. The lab reports need to be submitted through Canvas.

**Attendance & Punctuality:** To get credit for a laboratory activity, not only has the lab report to be submitted on time, but actual attendance of the laboratory is mandatory.

**Food and Drink:** It is often not safe to consume food or drinks in laboratories due to the presence of substances in labs which may not be safe when ingested. If hunger or thirst occurs during the laboratory class, please seek out a restroom, wash your hands thoroughly, and then consume food/drink outside of the classroom.

**Electronic Devices in Class:** Please turn your cell phone ringers off during the lab class. If you receive an urgent phone call, please step outside into the hallway to minimize disturbance to other students. Tablets and laptops are not required but can be quite useful to bring to this class in order to display some of the power point presentations which give extra detail to lab procedures.

**Canvas:** This class uses Canvas. Much of the instructional material will be deposited and available there. Lab reports will be submitted and graded through Canvas.

**Assignments:** Assignments will be provided through Canvas

**Grading Policy (Evaluation Methods & Criteria):**
Physics 3410/6750 are graded courses with letter grades A, B, C, D, or E assigned at the end of the course.
For the LABORATORY PORTION of Physics 3410 and 6750 there are 9 lab reports due. Seven lab reports are condensed lab reports and receive 10 points maximum. Two lab reports are more extensive and receive 15 pts maximum each. The maximum number of pts achievable is therefore 100pts.
Grading rubrics will be provided on Canvas for each lab activity. There is no separate laboratory letter grade assigned at the end of the semester. Instead, the laboratory performance will be included in the final grade assigned for Physics 3410/6750. Typically, the laboratory portion contributes 50% to the final grade, while the other 50% are from the lecture portion of the course, which is typically computed from homework scores as well as midterm and final exam scores.
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<thead>
<tr>
<th>Date</th>
<th>Topic/Discussion</th>
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<tbody>
<tr>
<td><strong>Week 1:</strong></td>
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<tr>
<td>Tue Aug 20</td>
<td>Laboratory sections do not yet meet in week 1</td>
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<tr>
<td>Wed Aug 21</td>
<td>Laboratory sections do not yet meet in week 1</td>
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<td><strong>Week 2:</strong></td>
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<tr>
<td>Tue Aug 27</td>
<td>Introductory Meeting</td>
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<td>Wed Aug 28</td>
<td>Introductory Meeting</td>
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<td><strong>Week 3:</strong></td>
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<tr>
<td>Tue Sep 3</td>
<td>Lab 1: Reflection, Refraction, Prism</td>
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<td>Wed Sep 4</td>
<td>Lab 1: Reflection, Refraction, Prism</td>
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<td><strong>Week 4:</strong></td>
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<tr>
<td>Tue Sep 10</td>
<td>Lab 2: Reflection and Refraction at Spherical Interfaces</td>
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<td>Wed Sep 11</td>
<td>Lab 2: Reflection and Refraction at Spherical Interfaces</td>
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<td><strong>Week 5:</strong></td>
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<td>Tue Sep 17</td>
<td>Lab 3: Experiments with the Telemicroscope</td>
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<td>Wed Sep 18</td>
<td>Lab 3: Experiments with the Telemicroscope</td>
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<td><strong>Week 6:</strong></td>
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<td>Tue Sep 24</td>
<td>Lab 4: Imaging with Single Lens, Depth of Field, Autocollimation Method, Spherical Aberration, Total Internal Reflection (Abbe's Method)</td>
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<tr>
<td>Wed Sep 25</td>
<td>Lab 4: Imaging with Single Lens, Depth of Field, Autocollimation Method, Spherical Aberration, Total Internal Reflection (Abbe's Method)</td>
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<td><strong>Week 7:</strong></td>
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<td>Tue Oct 1</td>
<td>Lab 5 Part 1: Dichroic Absorption, Polarization by Reflection, Polarization from Scattering</td>
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<td>Wed Oct 2</td>
<td>Lab 5 Part 1: Dichroic Absorption, Polarization by Reflection, Polarization from Scattering</td>
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<td><strong>Week 8:</strong></td>
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<td>Tue Oct 8</td>
<td>No Lab (Fall Break)</td>
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<td>Wed Oct 9</td>
<td>No Lab (Fall Break)</td>
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**Week 9:**
- **Tue Oct 15** Lab 5 Part 2: Birefringence, Optical Retardation, Circularly Polarized Light, Optical Activity
- **Wed Oct 16** Lab 5 Part 2: Birefringence, Optical Retardation, Circularly Polarized Light, Optical Activity

**Week 10:**
- **Tue Oct 22** Lab 6 Part 1: Double Slit with Laser and White Light
- **Wed Oct 23** Lab 6 Part 1: Double Slit with Laser and White Light

**Week 11:**
- **Tue Oct 29** Lab 6 Part 2: Interference by Plane Parallel Plates, Michelson and Fabry-Perot Interferometer
- **Wed Oct 30** Lab 6 Part 2: Interference by Plane Parallel Plates, Michelson and Fabry-Perot Interferometer

**Week 12:**
- **Tue Nov 5** Lab 7: Single Slit and Double Slit Diffraction (Intensity Function)
- **Wed Nov 6** Lab 7: Single Slit and Double Slit Diffraction (Intensity Function)

**Week 13:**
- **Tue Nov 12** Lab 8: Diffraction by Periodic and Non-Periodic Structures
- **Wed Nov 13** Lab 8: Diffraction by Periodic and Non-Periodic Structures

**Week 14:**
- **Tue Nov 19** Thanksgiving Week – no lab or do lab 9 already? (TBA)
- **Wed Nov 20** Thanksgiving Week – no lab or do lab 9 already? (TBA)

**Week 15:**
- **Tue Nov 26** Lab 9: Interferometer Experiments with Michelson and Fabry-Perot interferometer (Sodium Doublet, Index of Refraction of Air and Glass)
- **Wed Nov 27** Lab 9: Interferometer Experiments with Michelson and Fabry-Perot interferometer (Sodium Doublet, Index of Refraction of Air and Glass)

**Week 16:**
- **Tue Dec 3** Opportunity to make up a missed lab
- **Wed Dec 4** Opportunity to make up a missed lab

**Finals Week:**
Please note that the lab portion has no final exam. However, the lecture portion of the course will have a final exam.

*Note: This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.*