



SYLLABUS – Updated 4/4
OPTI 202L (1 unit)
Geometrical and Instrumental Optics Lab II
Spring 2022

Lab Schedule: (Room 438, Meinel)

Tuesday	Wednesday	Thursday
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---	1:00-3:50 pm -- sec. D	---
5:00-7:50 pm -- sec. C	5:00-7:50 pm -- sec. E	---

Lab Lecture: Friday, 11:00-11:50 am – Room 410

Description of Course

This lab course closely follows OPTI 202R, "Geometrical and Instrumental Optics II". It provides hands-on experience with most of the optical instruments studied in that course. If you are majoring in Optical Sciences & Engineering, then 202L is a required course. It is strongly recommended that 202L be taken concurrently with 202R, to optimize your learning. This lab course provides hands-on experience with most of the concepts and optical instruments studied in OPTI 202R. The overall "theme" of this lab course is to reverse-engineer a variety of optical instruments, and to use your knowledge of geometrical optics to study the paraxial properties of these instruments (magnifiers, eyepieces, telescopes, microscopes, binoculars, etc.). Optical lab techniques learned in OPTI 201L will be used to do this. In addition, we will do labs on laser beam alignment, optical dispersion, stops and pupils, and aberrations.

Course Prerequisites or Co-requisites

Students must be enrolled in, or have already taken OPTI 202R.

Instructor and Contact Information

Prof. Michael Nofziger ("Dr. Mike")

Meinel 412A

520-626-8363

nofziger@optics.arizona.edu

Office Hours: Tue. 1:00–3:00 pm or by appointment

Web information: Course notes may be found on the D2L site for this course, OPTI 202L.

Course Format and Teaching Methods

Weekly Labs with a weekly Lab Lecture.

Course Objectives

The main course objectives are to reverse-engineer a variety of optical instruments studied in OPTI 202R (magnifiers, eyepieces, telescopes, microscopes, binoculars, etc.), and to study first-hand their paraxial optical properties.

Expected Learning Outcomes, & Relationship to ABET a-k Objectives

Upon successful completion of this course, students will be able to:

- use commercial opto-mechanical hardware to do first-order alignment of laser beams (e)
- use an alignment microscope to position and align optical elements on an optical table (k)
- use a nodal slide to measure the cardinal points of a multi-element lens (k)
- make optical and mechanical measurements to 'reverse-engineer' various optical instruments (refracting and reflecting telescopes, microscopes, binoculars, etc.) (b,d)
- explain how various optical instruments work (eyepieces, refracting and reflecting telescopes, microscopes, binoculars, etc.) (g)
- explain the paraxial properties of camera lenses (telephoto and zoom lenses) (g)

Absence and Class Participation Policy

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Participating in the course, and attending lectures and all labs are vital to the learning process and being successful in this course. As such, attendance is required at all lectures and labs. Absences may affect your final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible.

If you are experiencing unexpected barriers to your success in your courses, please talk with your Undergraduate Academic Advisor, Amber Soergel (asoergel@optics.arizona.edu). To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu. The Dean of Students Office is a central support resource for all students and also may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

Required Texts or Readings

- All lab handouts and class notes will be made available through our class D2L webpage.
- You are required to keep lab notes in some type of bound lab notebook: (no loose sheets of paper).

Required or Special Materials

None.

COVID Concerns: As stated in the University of Arizona's latest COVID-19 Guidelines:

"As we enter the Spring semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit covid19.arizona.edu for the latest guidance." (1/10/2022)

Given the nature of this lab class (2 students working side-by-side at an optical table), we will not be able to maintain proper social distancing. Therefore:

► **Face Masks** (surgical or higher-grade KN95, KF94 and N99) **are required to be worn during the entirety of all lab sessions.**

Assignments and Examinations: Schedule/Due Dates

Weekly Lab Summary:

Due *one week* after you have done the lab. The Lab Summary is to be turned in at the start of the following week's lab. Each lab handout contains specific work tasks that need to be performed, and questions that need to be answered. They generally will be marked and easy to spot, but not always. Read the handout carefully and make sure you do all of the tasks, and answer all of the questions. The weekly Lab Summary that you turn in for a grade must include the following:

- One page of writing, in your own words, that contains the following 3 sections:
 - Objectives (describe the purpose of the lab)
 - Procedures and Equipment (a general description, NO step-by-step details!)
 - Summary (what was learned)

.....plus the following sections:

- All of your "raw" data (the actual readings you and your lab partner took in lab).
- All of your "processed" data (the results you calculated based on your raw data).
- Graphs of data (if appropriate—enlarge to fit at least half of a page).
- Results of computer work (if asked for).
- Answers to all of the questions (* or otherwise) in the lab handout.

Lab Summaries MUST be typed (computer-printed), and double-spaced. Hand-written Summaries will NOT be accepted. Lab Summaries MUST be written individually, in your own words. You may use data taken by your lab group, but the Lab Summary must be entirely your own work. If written as a group effort, it will be considered as plagiarism by everybody involved, and will be dealt with accordingly. (This includes a "group-written" Summary where only a few words were changed—that does NOT make it your own work.)

Pre- and Post-Lab Questions:

These will be clearly marked in the lab handout:

- **(Q1)** will mark a question.
- will mark something in the lab handout that needs to be included in the post-lab report (questions, observations, findings, etc.).

Pre-lab questions are due at the start of your week's lab session.

Weekly Lab Summaries are due at the start of your following week's lab session.

All work is to be submitted as pdf files to the appropriate D2L dropbox.

Final Examination or Project

There is no final exam in this course. Instead, the Final Analysis assignment takes the place of a final exam:

Final Analysis:

This will take the place of a traditional final exam/lab report. Identify 3 specific things that you don't understand about material covered in OPTI 202R OPTI 210, and/or OPTI 201L. Think critically about what it is that you don't understand about each item, and why you have had trouble understanding it. Write at least a half page for each item, explaining this.

Full credit will be earned for length (writing at least half of a page for each item), and content (the extent to which you demonstrate 'critical' thinking about your misunderstandings, NOT just complaining about something).

Final Lab Report and the Final Analysis--due by 5pm, Wed. May 4, 2022.

Grading Scale and Policies

Labs (100 points per Post-Lab Report x 13 labs): (including any pre-lab and/or post-lab questions)	POINTS 1300
Final Analysis	100
TOTAL	1400

- ***ALL of the Lab Summaries "count."* Unlike last semester in 201L, we are NOT dropping the two lowest scores!**
- Final grading for the class will be done on a curve. If your score falls "in-between" letter grades, input from your TA will be used to assess how you performed in lab, to make a final decision on your grade.
- **LATE POLICY:** All Lab Summaries are due at the start of your lab session, one week after you did that particular lab. **Late material will be accepted up to a week after it was due, and will be graded at 75% off. If you miss a lab, it may be made up only because of medical reasons or a family emergency. Sharing of data for lab makeup is NOT allowed. The lab should be made up by noon on the Monday following the lab session that you missed. If you miss a lab for other than an excused absence, no Lab Summary will be accepted.**
- **Missing Lab Summaries count as a "0".**

Incomplete (I) or Withdrawl (W)

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Scheduled Topics/Activities

Week 0: 10 January 2022

Lab Lecture on Friday, Jan. 14 to get started.

NO LABS this week—Get a bound notebook, read Lab #1, and answer the Pre-Lab Questions.

Week 1: 17 January 2022

Lab 1 : **Multiple Lens Systems—The Zoom Lens**

Paraxial design of a simple two-lens zoom system. SLR camera zoom lens.

Week 2: 24 January 2022

Lab 2: **Aberrations**

Week 3: 31 January 2022

Lab 3: **Stops, Pupils, and F/#**

Week 4: 7 February 2022

Lab 4: **The Simple Magnifier, Eyepieces**

Week 5: 14 February 2022

Lab 5: **Refracting Telescopes**

Afocal systems, Galilean and Keplerian designs, angular magnification, FOV, vignetting, field and relay lenses, exit pupil.

- Week 6: 21 February 2022**
 Lab 6: **The Golfscope...**
 Real-world example of a Keplerian Refracting telescope with a reticle.
- Week 7: 28 February 2022**
Lab 6: **The Golfscope (...continued.)**
complete optical prescription.
- Week 8: 7 March 2022**
(NO Labs this week—Spring Recess)
- Week 9: 14 March 2022**
 Lab 7: **Reflecting Telescopes**
 Optical properties of the individual mirrors and of the system.
 Angular magnification, FOV, exit pupil.
- Week 10: 21 March 2022**
 Lab 8: **Binoculars**
 Optical properties of the individual components, FOV, angular magnification, stray light, aberrations, exit pupil.
- Week 11: 28 March 2022**
 Lab 9: **The Compound Microscope**
 Magnification of the objective, the eyepiece, and the overall system.
 Telecentricity. Commercial microscopes.
- Week 12: 4 April 2022**
 Lab 10: **Optical Materials and Dispersion I**
 The prism spectrometer, optical layout and alignment.
 Dispersion curves, comparison to theoretical data.
- Week 13: 11 April 2022**
 Lab 11: **Optical Materials and Dispersion II**
 The Abbe Refractometer, TIR, unknown samples, optical layout of the instrument.
- Week 14: 18 April 2022**
 Lab 12: **Introduction to ZEMAX**
 Model of the human eye
- Week 15: 25 April 2022**
 Lab 13: **Opto-Mechanics and Optical Alignment: An Introduction**
 Co-alignment of 2 laser beams, cube beamsplitters, kinematic mirror mounts.
- Week 16: 2 May 2022**
NO LABS—Last Week of Classes
Lab #13 Report and Final Analysis due by 5pm, Wed. May 4.
- Week 17: 9 May 2022**
NO LABS--FINAL EXAM Week

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Please refrain from disruptive conversations with people sitting around you during our Lab Lectures (which includes whispering with your neighbor). Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave the classroom. However, I strongly encourage questions during class!

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Accessibility and Accommodations

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.

Please be aware that the accessible table and chairs in our classroom (room 410) should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

Student Assistance and Advocacy information is available at <http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Confidentiality of Student Records

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.