SYLLABUS
OPTI 201L (1 unit)
Geometrical and Instrumental Optics Lab I
Fall 2022

Lab Schedule: (Room 438, Meinel)

Tuesday	Wednesday	Thursday
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---	5:00-7:50 pm -- sec. E	---

Lab Lecture (in-person)**:** **Friday,** 11:00-11:50 am – Room 410, Meinel

Description of Course

This lab course closely follows OPTI 201R, "Geometrical and Instrumental Optics I". It provides hands-on experience with most of the concepts taught in that course. If you are majoring in Optical Sciences & Engineering, then 201L is a required course. It is strongly recommended that 201L be taken concurrently with 201R, to optimize your learning. The main objectives for this lab are to learn the basics of geometrical optics, image formation, and the optics of various optical instruments. A variety of optical lab techniques will also be taught. Underlying most of the labs are the concepts of image location and magnification.

Course Prerequisites or Co-requisites

Students must be enrolled in, or have already taken OPTI 201R.

Instructor and Contact Information

Prof. Michael Nofziger ("Dr. Mike") nofziger@optics.arizona.edu
Meinel 412A
520-626-8363
Office Hours: Thur. 1:00–3:00 pm or by appointment

Lab Teaching Assistant (Laura Sawyer) sawyerjlaura@email.arizona.edu

Web information: Course notes may be found on the D2L site for this course, OPTI 201L.

Course Format and Teaching Methods

Weekly Labs (***in-person***) with a weekly Lab Lecture (***in-person***).

Course Objectives

This lab course provides hands-on experience with most of the concepts taught in OPTI 201R. The main course objectives are to use commercially-available opto-mechanical lab equipment to learn first-hand the basics of geometrical optics, image formation, magnification, and the paraxial properties of various lenses and optical systems.

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.

Expected Learning Outcomes: [Relationship to ABET Student Outcomes (1-7)]

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

- use industry-accepted practices to clean optical elements (lenses, mirrors, etc.). (6)
- use micrometers and calipers to make mechanical measurements. (6)
- read and interpret vernier scales (of both linear and angular measurements). (6)
- use opto-mechanical hardware to position lenses and mirrors on optical rails. (6)
- use an alignment microscope to position and align optical elements on an optical table. (6)
- use a nodal slide to measure the cardinal points of a lens. (6)
- use a spherometer to measure the sag of an optical surface. (6)
- produce a collimated beam of light (autocollimation). (6)
- explain how the Snellen eye chart is used to test optical acuity. (3)
- communicate laboratory findings in both written and graphical form. (3,6)
- work with a lab partner throughout the semester (5)

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.

COVID-19: University of Arizona's latest COVID-19 Guidelines are at: www.covid19.arizona.edu
► ***As of 8/15/22, UA policy states: "…masks are recommended, but not required, in most indoor spaces including classrooms."***

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, double-spaced, and uploaded to D2L as a pdf file (NO PAPERS this semester). 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.)

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 201R 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 Analysis due by 5pm, Wed. Dec. 7, 2022.

Grading Scale and Policies

Weekly Lab Summary	100 points/lab (13 labs, 2 lowest scores dropped)	= 1100
Fingerprint Reader Project		= 300
Final Analysis	100 points	= 100
	TOTAL POINTS	**= 1500**

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" and cannot be dropped as either of the 2 lowest scores.

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.

(30 October) LAST DAY TO WITHDRAW FROM A CLASS ONLINE THROUGH UACCESS

Scheduled Topics/Activities

Week 1: **22 August 2022**
Lab 1: CLEANING OPTICS AND DATA ANALYSIS (Introduction)
Safety, Use of Low Output He-Ne Lasers, Proper Handling of Equipment, Data Handling and Presentation, Lab Write-ups, Grading, Measurement Scales, Care Cleaning and Handling of Optics.
Fingerprint Reader—Exercise #1: *Study the system, take measurements of all components, use a microscope to measure the CCD chip, clean all components.*

Week 2: **29 August 2022**
Lab 2: REFRACTIVE INDEX AND SNELL'S LAW
Total Internal Reflection, Pfund's Method, Microscope Method, Deviation by a Plane Parallel Plate
Fingerprint Reader—Exercise #2: *Measure the refractive indices of the prisms. Determine how a fingerprint is seen on the prism face.*

Week 3: **5 September 2022**
Lab 3: REFLECTION / SCANNERS
Reflection from Planar Surfaces, Image Parity, Periscopes, Kaleidoscopes, Signaling Mirrors, The Law of Reflection, Optics of Various Types of Scanners
Fingerprint Reader—Exercise #3: *Unfold the system about the mirror. Make a drawing to show the object plane orientation.*

Week 4: **12 September 2022**
Lab 4: PRISMS
Deviation: Right Angle Prism, Porro Prism, Porro-Prism Combination, Amici Prism, Penta Prism, Dove Prism, Cube Corner
Fingerprint Reader—Exercise #4: *Measure the beam diameter 'magnification' due to the pair of prisms. Study the effect on the final image.*

Week 5: **19 September 2022**
Lab 5: SCANNERS
Angle Doubling, Scan Patterns of Supermarket Scanners, Laser Printers, Computer Flat-Bed Scanners

Week 6: **26 September 2022**
Lab 6: IDEAL IMAGING
Pinhole Imaging, Lens Imaging, Image Quality, F-number, Depth of Focus
Fingerprint Reader—Exercise #5: *Measure the source uniformity and illumination.*

Week 7: **3 October 2022**
Lab 7: THIN LENSES
Object-Image Relationship, Method of Conjugates, The Spherometer, Double-Pinhole Method, Autocollimation

Week 8: **10 October 2022**
Lab 8: THE EYE
Anatomy and Geometrical Properties of the Human Eye
Fingerprint Reader—Exercise #6: *Measure the focal length of the 2 lenses.*

Week 9: **17 October 2022**
Lab 9: THICK LENSES I
The Nodal Slide

Week 10: **24 October 2022**
Lab 10: GAUSSIAN REDUCTION—The Telephoto Lens
Gaussian Reduction of Multiple-Lens Systems, Cardinal Points using the Nodal Slide

Week 11: **31 October 2022**
Lab 11: THICK LENSES II
Newtonian Distance, The Focometer
Fingerprint Reader—Exercise #7: *Gaussian reduce the 2 lenses into a single pair of principal planes. Calculate and measure the system magnification.*

Week 12: **7 November 2022**
(Veteran's Day Holiday -- Friday, Nov. 11 -- NO Lab Lecture)

Week 13: **14 November 2022**
Lab 12: THE SLR CAMERA ZOOM LENS—Opto-Mechanics
Cardinal Points Relative to the Camera Body, Opto-Mechanical Layout

Week 14: **21 November 2022**
NO LABS *(Thanksgiving – Nov. 24-25)*

Week 15: **28 November 2022**
Lab 13: THE SLR CAMERA ZOOM LENS—Radiometry
Throughput vs. F/#

Week 16: **5 December 2022**
NO LABS *Final Analysis DUE Wed., Dec. 7 by 5pm.*

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 or text chat with classmates during our Lab Lectures. 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 class. 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 barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu) to establish reasonable accommodations."

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