

GEOMETRICAL AND INSTRUMENTAL OPTICS LAB I

OPTI 201L, FALL 2011

Lab Schedule: (Room 438, Optical Sciences Center)

Tuesday	Wednesday	Thursday
8:00-10:50 am--sec. 1	---	8:00-10:50 am--sec. 6
1:00-3:50 pm--sec. 2	2:00-4:50 pm--sec. 4	1:00-3:50 pm--sec. 7
5:00-7:50 pm--sec. 3	5:00-7:50 pm--sec. 5	5:00-7:50 pm--sec. 8

Monday, 2:00-2:50 pm – Lecture Session in Room 410, Optical Sciences Center.

Dr. Mike Nofziger

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Office location: Optical Sciences Center, Room 412A

Office Hours: Tue. 2-4pm, Thurs. 2-4pm, and by appointment

Objectives:

This lab course has been designed to closely follow OPTI 201R, Geometrical Optics. It provides hands-on experience with most of the concepts taught in that course. If you are majoring in Optics, then 201L is a required course. It is strongly recommended that both courses be taken concurrently to optimize your learning. The main objectives for this lab center around understanding the basics of geometrical optics, image formation, and the optics of various instruments. A variety of optical lab techniques will also be taught. Underlying most of the labs are the concepts of image spatial location and image size.

Textbook:

Class Notes are available at the EES Copy Center, Harvill Room 137 (621-7502; 8:00am-5:00pm). You are required to keep lab notes in some type of bound lab notebook (no loose sheets of paper).

Grading:

Weekly Lab Summary:	100 Points/lab (<u>2 lowest scores dropped</u>) =	1100
Optical System Project	300 Points =	300
Final Analysis:	100 Points =	100
Lecture Session attendance:	100 Points =	100
TOTAL POINTS =		1600

Final grading will be done on a curve. If your score falls “in-between” 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. The lab must 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 medical reason, no Lab Summary will be accepted. *Missing Lab Summaries count as a “0” and cannot be dropped as either of the 2 lowest scores.*

Weekly Lab Summary:

Due *one week* after you have done the lab. The summary is to be turned in at the start of the following week's lab. From page 1-13 of the Lab Notes:

“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 sections:
 - Objectives (describe the purpose of the lab)
 - Procedures and Equipment (a general description, NO step-by-step details!)
 - Summary (what was learned)
- All of your “raw” data (the actual readings you 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.)

Optical System Project:

As part of this Project, you are required to keep notes in a separate “Optical System” section of your lab notebook. You will be graded on the content, attention to detail, and completeness of this portion of your notebook. This grading will be done at random times throughout the semester.

Final Analysis:

This will take the place of a traditional final lab report. Identify 3 specific things that you don't understand about material covered in OPTI 201R 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).

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Week 1: 22 August 2011

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, Homework problems as lab write-up.
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 2011

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 2011

NO Lab Lecture on Monday due to Labor Day holiday.

Lab 3: REFLECTION
Reflection from Planar Surfaces, Image Parity, Periscopes, Kaleidoscopes, Signaling Mirrors, The Law of Reflection
Fingerprint Reader—Exercise #3: Unfold the system about the mirror. Make a drawing to show the object plane orientation.

Week 4: 12 September 2011

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 2011

Lab 5: SCANNERS
Angle Doubling, Scan Patterns of Supermarket Scanners, Laser Printers, Laser Light Show

Week 6: 26 September 2011

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.

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Week 7: 3 October 2011

Lab 7: THIN LENSES

Object-Image Relationship, Method of Conjugates, The Spherometer, Double Pinhole Method, Autocollimation

Week 8: 10 October 2011

14 OCTOBER - LAST DAY TO DROP COURSE WITH A "W" (if passing)

Lab 8: THE EYE

Anatomy and Geometrical Optics of the Human Eye

Fingerprint Reader—Exercise #6: Measure the focal lengths of both lenses.

Week 9: 17 October 2011

Lab 9: THICK LENSES I

The Nodal Slide

Week 10: 24 October 2011

Lab 10: GAUSSIAN REDUCTION—The Telephoto Lens

Gaussian Reduction of Multiple-Lens Systems, Cardinal Points using the Nodal Slide

Fingerprint Reader—Exercise #7: Measure the Gaussian properties of both lenses. Calculate and measure the system magnification.

Week 11: 31 October 2011

Lab 11: THICK LENSES II

Newtonian Distance, The Focometer

Week 12: 7 November 2011

Lab 12: THE CAMERA LENS

Cardinal Points Relative to the Camera Body

Week 13: 14 November 2011

Lab 13: RADIOMETRY—The Camera Lens

Throughput vs. F/#

Week 14: 21 November 2011

NO LABS (*Thanksgiving - Nov. 24-25*)

Week 15: 28 November 2011

NO LABS

Week 16: 5 December 2011

NO LABS *Final Analysis and Lab Notebooks DUE Wed., Dec. 7 by 5pm.*