UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

# Course Syllabus

# OSE 3200L Geometric Optics Lab


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**Term:** Fall 2018
**Class Location:** A210
**Class Meeting Day:** Thursday
**Class Meeting Time:** 9-11:50am (section 1)
12-2:50pm (section 2)

**Website:** **Materials available on UCF Webcourses system**

**Office Hours: Same as OSE 3200 Lecture**

**Additional Notes:** I will be in my office at these times, but of course I will be happy to discuss the material with you anytime; drop by my office or contact me in advance to make an appointment. Often, I get questions via e-mail that can be quickly answered.

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**Course Catalog Description:** Laboratory for the companion course OSE3200 (Geometrical Optics). Introductory optics lab that studies the behavior of light as rays. Reflection, refraction, and transmission. Lenses, mirrors and prisms. Image formation and beam manipulation. Measure and characterize archetypal optical systems such as telescopes, cameras, and microscopes.

**Prerequisites:** You must have completed or be co-registered in OSE3200 (Geometrical Optics)

**Detailed Course Description and Learning Outcomes:**

**Detailed Description:**

Geometric optics is the study of light in its simplest form by treating light as rays. Light rays travel in straight lines until they encounter an interface (such as a mirror or a lens) where they may be redirected by reflection and refraction. This course provides hand-on experience working with light-sources, manipulating light and assembling optical systems. Labs explore the classical, ray behavior of light to describe behavior at interfaces and propagation through systems. This course provides practical experience working with optics in a laboratory environment including experience handling optics, assembling optomechanical components, conducting experiments and performing data analysis.

**Learning Outcomes:**

Upon completion of this course, students should understand the physical principles underlying geometrical optics and develop intuitive understanding of optical systems. They should understand how light propagates through optical systems and how to design/build simple systems. They should be able to characterize properties of common optical systems such as telescopes, imagers, luminaires and concentrators. For example, students should be able to:

- Choose optics to manipulate light sources to achieve a desired effect.

- Assemble an optical system.
- Characterize the properties of various optical systems.
- Design an imaging system with a desired resolution, field-of-view and magnification.
- Understand limitations in optical system performance.

**Integrated Learning:**

MATLAB is a critical computational tool for scientists and engineers. The O&P program has adopted teaching and using MATLAB throughout the curriculum. Students are expected to use their MATLAB proficiency from OSE 3200 to perform basic data analysis and fitting in one formal lab report.

**Topics: (A detailed schedule with dates follows at the end of this document.)**

1) Introduction to Geometric Optics – Light as Rays: Wave nature of light, propagation in homogeneous media, wavefronts and rays, radiometry, limits of geometrical optics.
2) Planar Optical Surfaces: Refractive index, optical path length, Fermat's principle, Snell's law, reflection and refraction, plane parallel plates, prisms, optical materials.
3) Curved Optical Surfaces: Image formation, lenses, optical spaces, image types, shape of optical surfaces, ray tracing, paraxial approximation.
4) Imaging: Lens design, thin lens model, magnification, ZZ' diagram, cardinal points, Gaussian optics, thick lenses, mirrors.
5) Apertures: Aperture stop, field stop, F-number, numerical aperture, depth of focus.
6) Example Optical Systems: Telescopes, cameras, microscopes, luminaires, concentrators, displays.
7) Aberrations: Diffraction limit, chromatic and monochromatic aberrations.

**Relationship of Course to ABET Criteria**

| ABET Criteria | Level of Emphasis During Course (Low, Medium, High) |
|---|---|
| (a) An ability to apply knowledge of mathematics, science, and engineering. | High |
| (b) An ability to design and conduct experiments, as well as to analyze and interpret data. | High |
| (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. | Medium |
| (d) An ability to function on multidisciplinary teams. | Medium |
| (e) An ability to identify, formulate, and solve engineering problems. | High |
| (f) An understanding of professional and ethical responsibility. | Medium |
| (g) An ability to communicate effectively. | Low |
| (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. | Low |
| (i) A recognition of the need for, and an ability to engage in life-long learning. | Low |
| (j) A knowledge of contemporary issues. | Low |
| (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. | High |

**Textbook:**

*Geometrical and Trigonometric Optics*, 1st ed., E. L. Dereniak, and T. D. Dereniak, Cambridge University Press 2008. *(The digital version of the course textbook is available for free through the UCF Libraries. You can view it on the Web or download a PDF version to read offline. Accessing the text off-campus requires that you authenticate as a UCF student. Link: https://www.cambridge.org/core/books/geometrical-and-trigonometric-optics/41792CC511FABC71B070C0747CBB42D0 )*

**Course Grading and Requirements for Success:**

| Criteria | Grade Weighting |
|---|---|
| Lab participation | 20% |
| Lab notebooks | 60% |
| Formal lab report | 20% |
| Total | 100% |

**Final Exam Date: N/A**

**Make Up Policy:** If an emergency arises and a student cannot participate in a lab on the scheduled date, the student **must** give notification to the instructor **no less than 24 hours before** the scheduled date or deadline.

**Financial Aid and Attendance:** As of Fall 2014, all faculty members are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete the provided academic activity by the end of the first week of classes, or as soon as possible after adding the course, but no later than **August 25**. Failure to do so will result in a delay in the disbursement of your financial aid.

| Grading Scale (%) | Rubric Description |
|---|---|
| A | Excellent, has a strong understanding of all concepts and is able to apply the concepts in all and novel situations. Has full mastery of the content of the course. |
| B | Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations. |
| C | Satisfactory, has a basic understanding of the major concepts of the course and is able to apply to basic situations. |
| D | Below satisfactory, has a basic understanding of only the simple concepts and is able to apply to only a limited number of the most basic situations. |
| F | Demonstrates no understanding of the course content. |

**Grade Objections:**
All objections to grades should be made **in writing within one week** of the work in question.
Objections made after this period has elapsed will **not** be considered – NO EXCEPTIONS.

**Homework Policy:**
Labwork and write-ups are expected to be completed during the lab session. Hard copy of each lab write-up is due the same week of the lab assignment and students will generally turn it in at the end of the scheduled lab period. Lab time will be allotted for data analysis and writing for one formal lab report, but students may require extra time outside of class to complete the formal report.

**Class Website:**
Materials used for classes will be available on UCF Webcourses for download before each class.

**Teaching vs. Learning:**
Most people learn things for themselves, the lab is an excellent opportunity for experiential learning. You should come prepared with knowledge of the upcoming lab exercise described in the lab manual. Bring an inquisitive mind and a desire to gain understanding, rather than simply complete the lab as quickly as possible. Lab will usually begin with a quiz followed by brief instruction reminding you of relevant lecture content and discussing the lab exercise.

**Professionalism and Ethics:**
Per university policy and plain classroom etiquette, mobile phones, etc. must be silenced during all classroom lectures, unless you are specifically asked to make use of such devices for certain activities. Academic dishonesty in any form will not be tolerated! If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule in the UCF Student Handbook (www.goldenrule.sdes.ucf.edu) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

It is the nature of a laboratory course that you will be working in groups. Obviously, those of you who are lab partners will be using the same raw data. You are encouraged to discuss your observations and insights with your lab partners; however, each of you has to write your own ORIGINAL lab reports. Providing a fellow student with experimental data from an experiment in which he/she did not participate is a form of plagiarism and is forbidden. You are encouraged to use the internet as a resource for your final report; however, electronic copying and pasting of material directly into reports and papers without proper reference of the source is blatant plagiarism. **Always reference the sources of information.** If there is any question concerning acceptable practice in this laboratory course, don't hesitate to ask the instructor.

**Students with Special Testing/Learning Needs:**
Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at www.sds.sdes.ucf.edu or at (407)823-2371.

**Dates:**

| | |
|---|---|
| First Day of Class: | 8/23/2018 |
| Last Day to Drop Classes: | 8/23/2018 |
| Withdrawal Deadline: | 10/26/2018 |
| Last Day of Class: | 11/31/2018 |
| Final Exam: | N/A |

| **OSE 3200L Geometric Optics Lab, Fall 2018**<br>**Daily Schedule (subject to change)** | | |
|---|---|---|
| Week | Date | Concepts Presented: |
| 1 | August 23 | **Introduction to the lab, laser safety and Lab #0** |
| 2 | August 30 | **Lab #1: Light sources and Radiometry** |
| 3 | September 6 | **Lab #2: Reflection and Refraction** |
| 4 | September 13 | **Lab #3: Prisms and Dispersion** |
| 5 | September 20 | **Lab #4: Lens Shape, Power and Focal Length** |
| 6 | September 27 | **Lab #5: Gaussian Imaging** |
| 7 | October 4 | **Lab #6: Pinhole Camera and Imaging** |
| 8 | October 11 | **Lab #7: Multiple Lenses** |
| 9 | October 18 | **Formal Report – Draft Due** |
| 10 | October 25 | **Lab #8: Two-Lens Systems** |
| 11 | November 1 | **Project: Build a Telescope (Week 1)** |
| 12 | November 8 | **Project: Build a Telescope (Week 2)** |
| 13 | November 15 | **Formal Report Writing** |
| 14 | November 22 | **No Lab - Thanksgiving break** |
| 15 | November 29 | **Lab 9: Aberrations** |