



CREOL, The College of Optics and Photonics

OSE4240: Intro to Optical Design
CREOL, The College of Optics and Photonics
Credit Hours: 3
Term: Spring 2023

Syllabus

Time:	Tue & Thur, 6:00pm – 7:15pm, 1/9/2023 – 4/23/2023
Location:	CREOL, A214
Prerequisites:	OSE 3052 Introduction to Photonics and OSE 3200 Geometric Optics.
Course Description:	Introduction of the main concepts in optical system design. Discussion on aberration theory. Analysis of the performance of the optical system. Assessment of image quality using optical design software.
Instructor:	Dr. Kyle Renshaw
Email/Contact Info:	krenshaw@creol.ucf.edu
Office Hours:	TBD @ CREOL A209
Course Modality:	P (In-person)
GTAs:	None
Class Webcourse:	https://webcourses.ucf.edu/courses/1424599
Office Hours:	TBD @ CREOL A209
Additional Notes:	Outside of office hours, please contact me via webcourses or e-mail to ask questions or schedule a meeting. Often, I get questions that can be quickly answered via e-mail.

Course Materials:

No textbook is required but the following books are recommended for reference.

- Introduction to Lens Design: With Practical Zemax Examples, Willmann-Bell, 2002
- Introduction to Lens Design, Jose Sasian, Cambridge, 2019 (free @ UCF: [link](#))
- A Course in Lens Design, Chris Velzel, Spring, 2014 (free @ UCF: [link](#))
- Optical System Design, 2nd ed., Robert Fisher, MacGraw-Hill, 2008

Students must have access to a computer where they can install Zemax for use throughout the semester.

Detailed Description:

Analysis of optical systems consisting of lenses, mirrors, and apertures. Image plane, principal planes, and entrance and exit pupils. Magnification, field of view, F number, image-plane irradiance. Assessment of image quality resulting from diffraction and geometrical and chromatic aberrations, using optical design software. Analysis and design of photonic systems including systems consisting of waveguides and integrated-optic components. Numerical simulation using photonic design software.

Learning Outcomes:

Upon completing this course, the students will:

- Master the concept of ray-tracing and understand the aberration theory.
- Evaluate the performance for imaging optical system based on aberration theory.
- Understand the major design constraints in manufacturing and properties in optical materials.
- Get familiar with common lens-based imaging instruments and design criteria.
- Design simple imaging optical systems using commercially available software (Zemax).

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

- Analysis of optical systems consisting of lenses, mirrors, and apertures.
- Image plane, principal planes, and entrance and exit pupils. Magnification, field of view, F number, image-plane irradiance.
- Ray tracing invariants. Ray tracing using a spread sheet and optical design software.
- Wave front aberration and assessment of image quality resulting from diffraction.
- Seidel's 3rd order aberrations and chromatic aberrations.

Course Grading and Requirements for Success:

Criteria	Grade Weighting
Homework (~5 problem sets)	50%
Quizzes and Participation (~3 quizzes)	10%
Midterm Exam	20%
Final Project	20%
Total	100%

Final Project Due Date: 4-6:50PM on 5/2/2023

Grading Scale (%)	Rubric Description
100 ≥ A > 90	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 ≥	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
> D ≥	Below average, 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 ≥ 0	Demonstrates no understanding of the course content.

Make Up Policy: If an emergency arises and a student cannot submit assigned work on or before the scheduled due date or cannot take an exam on the scheduled date, the student **must** give notification to the instructor **no less than 24 hours before** the scheduled date and **no more than 48 hours after the** scheduled date.

Assignment Submission:

All assignments must be submitted online through webcourses. Responses on paper must be photographed or scanned for uploading; it must be clearly readable or will not be graded. Quizzes and exams will be proctored virtually, using ProctorHub, which requires you work seated in front of a camera for the duration of the assignment. Late homework will be accepted with a penalty of 10 points lost per day.

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.

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 posted academic activity by the end of the first week of classes. Failure to do so will result in a delay in the disbursement of your financial aid.

Deadlines, Holidays, and Significant Semester Events: (all in 2023)

First Day of Class	1/10
Last Day of Class	4/20
Last Day to Add/Drop Classes	3/13
Withdrawal Deadline	3/24
Martin Luther King Jr. Day (no class)	1/16
Spring Break (no class)	3/13 – 3/17
Midterm	~3/9
Final Project Due	5/2

Teaching vs. Learning: Most people learn things for themselves. As a teacher, my job is to help students to learn the material. In order to help you learn in depth, I will use class time to introduce the material/concepts and work examples using these concepts to solve problems. It is your responsibility to learn the material and much of this learning will come outside of class time, e.g. by working homework problems, studying for quizzes/exams and discussing concepts or problems with fellow students and myself. Students are expected to read and understand the textbook in addition to attending class. I will occasionally hold quizzes to ensure that students come to class prepared.

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.

Student Learning Outcomes and Measures

This elective course is not required to address any ABET learning outcomes or measures.

Assessment and Grading Procedures

Homeworks, quizzes and exams will be graded and returned through webcourses.

Grade Dissemination

Grades and graded assignments will be posted on webcourses.

Policy Statements

Academic Integrity

Students should familiarize themselves with UCF's Rules of Conduct at <https://scai.sdes.ucf.edu/student-rules-of-conduct/>. According to Section 1, "Academic Misconduct," students are prohibited from engaging in

1. Unauthorized assistance: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
2. Communication to another through written, visual, electronic, or oral means: The presentation of material which has not been studied or learned, but rather was obtained through someone else's efforts and used as part of an examination, course assignment, or project.
3. Commercial Use of Academic Material: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor's PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
4. Falsifying or misrepresenting the student's own academic work.
5. Plagiarism: Using or appropriating another's work without any indication of the source, thereby attempting to convey the impression that such work is the student's own.
6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.
7. Helping another violate academic behavior standards.
8. Soliciting assistance with academic coursework and/or degree requirements.

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should familiarize themselves with the procedures for academic misconduct in UCF's student handbook, *The Golden Rule* <https://goldenrule.sdes.ucf.edu/>. UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student

organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

Unauthorized Use of Websites and Internet Resources

There are many websites claiming to offer study aids to students, but in using such websites, students could find themselves in violation of academic conduct guidelines. These websites include (but are not limited to) Quizlet, Course Hero, Chegg Study, and Clutch Prep. UCF does not endorse the use of these products in an unethical manner, which could lead to a violation of our University's Rules of Conduct.

They encourage students to upload course materials, such as test questions, individual assignments, and examples of graded material. Such materials are the intellectual property of instructors, the university, or publishers and may not be distributed without prior authorization. Students who engage in such activity could be found in violation of academic conduct standards and could face course and/or University penalties. Please let me know if you are uncertain about the use of a website so I can determine its legitimacy.

Unauthorized Distribution of Class Notes

Third parties may attempt to connect with you to sell your notes and other course information from this class. Distributing course materials to a third party without my authorization is a violation of our University's Rules of Conduct. Please be aware that such class materials that may have already been given to such third parties may contain errors, which could affect your performance or grade.

Recommendations for success in this course include coming to class on a routine basis, visiting me during my office hours, connecting with the Teaching Assistant (TA), and making use of the Student Academic Resource Center (SARC), the University Writing Center (UWC), the Math Lab, etc. If a third party should contact you regarding such an offer, I would appreciate your bringing this to my attention. We all play a part in creating a course climate of integrity.

In-Class Recording

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach enrolled students about a particular subject.

Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, private conversations between students in the class or between a student and the faculty member, and invited guest speakers is prohibited.

Recordings may not be used as a substitute for class participation and class attendance and may not be published or shared without the written consent of the faculty member. Failure to adhere to these

requirements may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule.

Course Accessibility Statement

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) <http://sas.sdes.ucf.edu/> (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371).

For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

Deployed Active Duty Military Students

If you are a deployed active duty military student and feel that you may need a special accommodation due to that unique status, please contact your instructor to discuss your circumstances.

Campus Safety Statement

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
- Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide's physical location and review the online version at <https://centralflorida-prod.modolabs.net/student/safety/index>.
- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.
- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <https://ehs.ucf.edu/automated-external-defibrillator-aed-locations>.
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on "Student Self Service" located on the left side of the screen in the toolbar, scroll down to the blue "Personal Information" heading on the Student Center screen, click on "UCF Alert", fill out the information, including e-mail address, cell phone number, and cell phone provider, click "Apply" to save the changes, and then click "OK."
- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this video <https://youtu.be/NIKYajEx4pk>.

Weekly Schedule

COURSE, TERM, INSTRUCTOR			
Daily Schedule (subject to change)			
Week	Starts	Concepts Presented:	Slides
1	1/10	Introduction, Review of Geometric Optics	1
2	1/17	Review of Imaging Systems	2
3	1/24	Matrix representation, Invariants, Ray trace spreadsheet	3
4	1/31	Zemax, Exact Ray Tracing	4
5	2/7	Introduction to aberrations, lens characterization (spot analysis, MTF, PSF) and scaling	5
6	2/14	3 rd order aberrations (Seidel)	6
7	2/21	Lens Design Process	7
8	2/28	Lens Design Examples (landscape, field flattener)	8
9	3/7	Midterm Review and Exam	
10	3/14	Spring Break (no class)	
11	3/21	Chromatic Aberrations	9
12	3/28	Achromat and Apochromat lenses	10
13	4/4	Example Lens Designs (double Gauss, telescope, fisheye)	11
14	4/11	Guest Lectures	
15	4/18	Advanced Surface Elements	12