

Regardless of course type; e.g., traditional, media-enhanced, or Web, syllabi at UCF are required to include:

- Course title and number
- Credit hours
- Name(s) of instructor(s)
- Office location
- Office or Web hours
- Course goals
- Course description
- Course requirements
- Methods of evaluation; grading system, including plus and minus grade policy, how grades will be posted
- Makeup exam policy
- Required and optional texts
- Final exam date and time
- Financial Aid Statement
- Other required course material

PRIOR TO PRINTING, DELETE THIS LINE AND ABOVE  
ALTER THE SYLLABUS BELOW TO YOUR LIKING



## Course Syllabus

### OSE6265 Optical Systems Design, 3 Credit Hours

<b>Instructor:</b> Shuo Pang	<b>Term:</b> 2021 Summer
<b>Email:</b> <a href="mailto:pang@creol.ucf.edu">pang@creol.ucf.edu</a>	<b>Class Meeting Days:</b> MoWe
<b>Phone:</b>	<b>Class Meeting Time:</b> 10:00-11:45
<b>Office:</b> 407-823-6869	<b>Class Location:</b> Online
<b>Office Hours:</b> Tuesday 15:00-16:00	<b>Website:</b>

**Additional Notes:** I will be in my office during office hours, but of course I will be happy to discuss the material with you anytime. Please send me an email if you would like to schedule a meeting.

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#### Course Catalog Description:

Design principles of lens and mirror optical systems; evaluation of designs using computer techniques.

#### Prerequisites:

OSE 5203 Geometric Optics;

## **Detailed Course Description and Learning Outcomes:**

### **Detailed Description:**

This course is designed to provide a comprehensive foundation in design principles of optical systems, as well as the evaluation and optimization of designs using computer techniques. The lectures include an introduction to optical systems design, an introduction to the Zemax optical design software package, paraxial layout, raytracing, stops and pupils, lens design methods, optimization, achromatization, optical aberrations, and image quality metrics. Various classic lenses and optical systems will be studied using the theoretical and computer skills learned in class. Students will learn 1st and 3rd-order calculations, optical design code skills including optimization and image analysis, and optical design philosophy and practical skills.

### **Learning Outcomes:**

Upon completing this course, the students will:

- Evaluate the performance for imaging optical system based on aberration theory.
- Understand the major design constraints in manufacturing and properties in optical materials.
- Understand with common lens-based imaging instruments and design criteria.
- Design basic 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 optical design software.
- Wave front aberration and assessment of image quality resulting from diffraction. Seidel's 3<sup>rd</sup> order aberration and chromatic aberrations.
- Lens design examples in common optical instruments.

## **Relationship of Course to ABET Criteria**

### **Textbook:**

Introduction to Lens Design: With Practical Zemax Examples, Willmann-Bell, 2002

### **Recommended Reference:**

*Geometrical Optics and Optical Design*, Mouroulis and Macdonald, Oxford University Press

*Practical Computer-aided Lens Design*, Gregory H. Smith, William-Bell, Inc. (1998)

*Modern Lens Design*, Warren J. Smith, McGraw Hill (1992)

*Elements of Modern Optical Design*, Donald C. O'Shea, Wiley Series of Pure and Applied Optics

*Handbook of Lens Design*, Malacara and Malacara, Marcel Dekker, Inc. (1994)

### **Other Reference Books:**

## **Course Grading and Requirements for Success:**

**Homework: 8 problem sets.**

**Exams: Midterm project**

**Quizzes: 3-5 quizzes**

**Final Exam: Final projects on lens design**

**Make up Exam 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

**Attendance:**

Criteria	Grade Weighting
Homework	50%
Quizzes and participation	10%
Midterm project	20%
Final project	20%
Total	100%

**Final Exam Date:**

**Financial Aid and Attendance:** As of Fall 2018, 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 following 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 27. Failure to do so will result in a delay in the disbursement of your financial aid.

Grading Scale (%)	Rubric Description
100 ≥ A > 85	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.
85 > B ≥ 75	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
75 > C ≥ 65	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
65 > D ≥ 60	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.
60 > F ≥ 0	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.

**Class Website:**

Materials used for classes will be available on UCF Webcourses for download before each class. I

**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](http://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.

**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](http://www.sds.sdes.ucf.edu) or at (407)823-2371.

**Dates:**

First Day of Class	May 17 <sup>th</sup> 2021
Last Day to Drop Classes:	May 21 <sup>st</sup> 2021
Last Day to Add Classes:	May 21 <sup>st</sup> 2021
Final Project due:	Aug 6 <sup>th</sup> 2021

<b>COURSE, TERM, INSTRUCTOR</b>			
<b>Daily Schedule (subject to change)</b>			
Week	Notes #	Concepts Presented:	Textbook chapter
1	1	Introduction of optical design. Review of geometrical optics	Ch 1
	2,3	From Maxwell's equation to ray tracing. Snell's law/Fermat Principle. Zemax Introduction,	Ch 2
2	3,4	Conventions, spherical surface expansion and paraxial ray tracing approximation Thin Lenses. Newton's formula. Thin lens system.	Ch 3
	5	Cardinal point, principle plane. Stops and pupils, marginal and chief ray. Matrix representation. Invariants, Paraxial ray tracing using spread sheet. Calculating pupils, focal length using spread sheet.	Ch 4, Ch 5
3		Memorial Day Break	
	6	Non paraxial ray tracing. Wavefront/lateral aberration, MTF, PSF	Ch 6
4	7	3 <sup>rd</sup> order aberrations I (Seidel's aberrations) and coefficient calculation,	Ch 7
	8	Solves and merit function, Landscape lens	Ch 8, Ch 9
5	9	Lens splitting, lens bending and aberration balancing	Ch 10, 11
	10	Symmetry and periscope lens, Coma and Astigmatism	Ch 12, 13
6	11	Field curvature and field flattener, Distortion	Ch 14, 15
	12	Chromatic aberration (dispersion), axial color and achromats	Ch 16
7	13	Achromats bending	Ch 16, 17
	14	Secondary color and large air-spaced achromat	Ch 18, 19
8		Mid-term Exam	Ch 20
	15	Apochromat & Eyepiece Design	Ch 21, 22
9	16	Field Lens Windows & Mirror and Corrector Plates	Ch 23, 24
	17	Symmetric Achromats and Vignetting & Telescopes	Ch 25, 26
10	18	Relating Defocus, Astigmatism, and Field Curvature & Celor Lens	Ch 27, 28
	19	Coddington's Equations & Triplet Lens and Image Compactness	Ch 29, 30
11	20	Strehl Ratio & Axial Intensity and Depth of Focus	Ch 31, 32
	21	Petzval & MTF, Image Quality	Ch 33, 34
12	22	Null lens Design & Beyond this course	Ch 35, 37, 38
	23	Final	Ch 36