EE 529 Optics Fall, 2022

Course Summary

Abstract

This course is designed to be the first course of the optics program core sequence. As such, the course focuses on geometrical optics, optical system design, and an introduction to the principles of physical optics. The principal phenomenon investigated is the interaction of light with optical materials (such as dielectrics and metals), optical elements (such as simple and compound lenses, prisms, and mirrors) and combinations of optical elements (optical systems such as microscopes and telescopes) in the geometrical optics limit, including the effects of absorption, dispersion, polarization, and interference. Emphasis is placed throughout on a balanced combination of fundamental principles and practical system design considerations.

Topics to be covered include: Wave motion, electromagnetic theory, the quantum nature of light (including the photoelectric effect and wave-particle duality), light propagation (including the laws of reflection and refraction), the paraxial approximation central to the geometrical optics model, thin lenses, mirrors, prisms, thick lenses (introduction), optical instrument design and optimization, the human eye as an optical instrument (including the neurobiological basis of low-level vision), the origins and control of optical aberrations, wave superposition (if time permits), polarization phenomena (including a treatment of the generation, analysis, and utilization of polarized light for both scientific and technological applications), linear and circular dichroism, linear and circular birefringence (optical activity), and form birefringence.

Related topics of interest (covered in other courses) include diffraction theory (based on the Kirchhoff scalar diffraction approximation, and including the Fresnel and Fraunhofer regimes), Fourier optics (particularly as applied to optical information processing and computing), and the theory of full and partial coherence.

Potential follow-on courses include Optical Materials, Instruments, and Devices; Physical Optics; Advanced Geometrical Optics; Advanced Physical Optics; Integrated and Fiber Optics; Optical Information Processing (Fourier Optics and Holography); Optical Computing; Nonlinear Optics; and Optical Fiber Communication Systems.

Instructor

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Office Hours: Immediately after class: Just outside the classroom
Tuesday and Thursday 6:30 p.m. to 8:00 p.m.
OHE 230 or 520 Seaver Science Center
For Fall, 2022, the schedule will be determined in consultation with the class

Graduate Teaching Fellow

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Course Requirements

1. Homework Sets

Homework sets will be designed to increase problem solving aptitudes and skills, to illustrate concepts discussed in lecture, and to investigate certain critical phenomena in depth. They will be given out approximately once every two weeks, due in approximately two weeks, with due dates as given in the Course Calendar. If due dates are changed during the semester, the new dates will be discussed in class and posted to the course web site. A separate weekly workshop session will be arranged for review of the homework solutions, and to provide a forum for discussion of questions regarding the course material.

Students are strongly encouraged to make use of additional references and to ask questions of the Instructor and Teaching Fellow, but are required to produce their own independent solutions to the problems. Discussions among students regarding the subject matter covered by the course is highly encouraged. Collaboration among students regarding specific homework problems is not expressly forbidden, but is discouraged. Copying of solutions, though, or reading another student's homework paper while doing one's own homework, is expressly forbidden. The principal value of the homework sets is to develop your own problem solving methods and skills.

Within each homework set, several of the problems will be straightforward, and designed to familiarize students with a particular key concept. Often, these problems will couple together more than one concept, in order to demonstrate the multifaceted nature of the subject matter, and to forge connections among seemingly unrelated topics that do in fact have a common underpinning or conceptual root.

Two unusual features will be noted and stressed in the various homework sets. First, in consideration of the fact that real-life problems in science and engineering are almost never well-specified, some problems will either present data that is unnecessary for the solution of the problem, or will not present enough information for a satisfactory solution. In the former case, you are expected to identify the extraneous piece(s) of information, and explain why it is (or they are) not needed. In the latter case, you are expected to make a reasonable assumption, carefully justify your rationale for the assumption you've made, and then proceed to solve the problem.

Second, the course will include numerous design problems, in which you will be asked to consider a particular design goal, make necessary assumptions, couple concepts together as necessary, develop a coherent design that satisfies the design goals, and in some cases analyze the system performance given your particular design. Examples of such design problems might include a wavelength dispersing prism design, an optical imaging system design, or a polarization component design.

2. Midterm Examination

The midterm examination will be approximately two hours in length, and will be open textbooks, open notes, and open homework.

3. Final Examination

The final examination will be approximately two hours in length, and will be open textbooks, open notes, and open homework.

Grading Policy

The course grade will be derived from all of the course requirements, and will be weighted in approximately the following manner:

- Homework, 30%
- Midterm Examination, 30%
- Final Examination, 40%

Statement on Academic Integrity

Students who violate University standards of academic integrity are subject to disciplinary sanctions, including failure in the course and suspension from the University. Since dishonesty in any form harms the individual, other students, and the University, policies on academic integrity will be strictly enforced. You are expected to familiarize yourself with the Academic Integrity guidelines found in the current *Scampus (http://scampus.usc.edu/)*, as well as throughout this course summary and as presented in class.

Course Textbooks

Required:	Hecht, E., *Optics*, Addison-Wesley, Reading, Massachusetts, (2015), 5th Ed., or
	Hecht, E., *Optics*, Addison-Wesley, Reading, Massachusetts, (2002), 4th Ed.
Recommended:	Klein, M. V. and T. E. Furtak, *Optics*, Wiley, New York, (1986), 2nd Ed.

Course Calendar

22 August, 2022 (Monday)	First Day of Fall Semester Classes
23 August, 2022 (Tuesday)	First EE 529 Class
5 September, 2022 (Monday)	Labor Day (University Holiday)
8 September, 2022 (Thursday)	Homework Set 1 Due
9 September, 2022 (Friday)	Last Day to Register and Add Classes
9 September, 2022 (Friday)	Last Day to Drop Without a "W" (Receive a Tuition Refund)
9 September, 2022 (Friday)	Last Day to Change Enrollment Option: (From Credit to Audit)
9 September, 2022 (Friday)	Last Day to Change Enrollment Option: (Pass/No Pass to Letter Grade)
22 September, 2022 (Thursday)	Homework Set 2 Due
6 October, 2022 (Thursday)	Homework Set 3 Due
7 October, 2022 (Friday)	Last Day to Drop Without a "W" (No Tuition Refund)
13 October – 14 October, 2022	Fall Recess
20 October, 2022 (Thursday)	Homework Set 4 Due
3 November, 2022 (Thursday)	Homework Set 5 Due
3 November, 2022 (Thursday)	Midterm Examination Review Session (Tentative)
6 November, 2022 (Sunday)	Midterm Examination (Tentative)
11 November, 2022 (Friday)	Last Day to Drop With a "W"
17 November, 2022 (Thursday)	Homework Set 6 Due
23 November – 27 November, 2022	Thanksgiving Recess
1 December, 2022 (Thursday)	Homework Set 7 Due
2 December, 2022 (Friday)	Fall Semester Classes End

3 December – 6 December, 2022	Stop Period (Study Days)
7 – 14 December, 2022	Final Examination Period
11 December, 2022 (Sunday)	Final Examination Review Session
13 December, 2022 (Tuesday)	EE 529 Final Examination, 11:00 a.m. - 1:00 p.m. (2:00 p.m.)
15 December, 2022 – 9 January, 2023	Winter Recess