EE 642 Advanced Geometrical Optics **Spring, 2019**

Course Summary

Abstract

This course on advanced geometrical optics is designed to be the second course of the optics program core sequence, following EE 529 Optics.

The first course in the sequence (EE 529) 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 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 polarization.

This course (EE 642) extends the understanding of fundamental optical principles and the analysis of optical systems to include non-paraxial behavior, thick lenses, the effects of aberrations, and key applications of physical optics, including optical interference phenomena and diffractive optical elements. Emphasis is placed throughout on a balanced combination of fundamental principles and practical system design considerations.

Topics to be covered include: The parametrization and analysis of thick lenses, matrix methods, optical ray tracing techniques, the origins and control of optical aberrations, advanced optical instrument design and optimization, wave superposition (both coherent and incoherent), interference theory and applications, thin film interference filters, infrared optics and optical systems, and diffractive optical elements.

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 Physical Optics; Integrated and Fiber Optics; Fourier Optics; Optical Information Processing and Holography; Optical Computing; and Optical Communications.

Instructor

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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, as well as throughout this course summary and as presented in class.

EE 642 Course Website

https://blackboard.usc.edu

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Course Requirements

1. Term Project

A term project will be required on a pre-approved problem statement developed by you and of relevance to the course. The principal purpose of the project is to develop a well-formulated question, problem, or optical system design goal based on the key concepts learned in both EE 529 and EE 642. The project will include an explanation of the basic features of a given phenomenon, technique, device, or optical system, and will then utilize the methods developed in the course to either answer the question (or series of questions), solve the problem, or produce a viable optical system design.

The term project when completed will be written up as a paper of approximately fifteen to twenty pages in length, and must clearly articulate (a) the topic of interest, (b) the well-formulated question(s), problem, or optical system design goal concerning the topic, (c) the solution to the question(s) or problem, or a viable optical system design that satisfies the design goal(s), and (d) a discussion of follow-on questions or future research directions.

Further details will be provided as the course proceeds, including specific instructions on how to choose a topic; formulate a question, problem, or optical system design goal; execute a viable solution or optical system design; and articulate the essence of the project and its solution or proposed design.

2. Oral Presentation of Term Project

To gain extremely important experience in the oral presentation of research and engineering results, each student will present a thirty minute summary of the term project, followed by a fifteen minute question and answer period. All registered students will participate in the oral presentation sessions, which will be scheduled in separate sessions during the last week of classes.

Updates on progress with each project will be given throughout the semester, and everyone should be prepared at each class period to briefly discuss their progress on the project, and any technical difficulties or conceptual issues encountered. The full class will participate in asking questions about each project, and also in offering possible directions for resolution of difficulties or conceptual ambiguities.

Further details will be provided as the course proceeds, including specific tips and pointers on how to prepare, practice, and deliver excellent scientific and engineering presentations. These tips and pointers will also be very useful in other courses, conference presentations, and job interview presentations.

Grading Policy

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

- Class Participation, 25%
- Oral Presentation of Term Project, 35%
- Term Project (Paper), 40%

Course Textbooks

Required:

Eugene Hecht, *Optics*, Addison-Wesley, Reading, Massachusetts, (2002), 4th Edition

Donald C. O'Shea, Thomas J. Suleski, Alan D. Kathman, and Dennis W. Prather, *Diffractive Optics: Design, Fabrication, and Test*, Tutorial Texts in Optical Engineering, TT62, SPIE Press, Bellingham, Washington, (2004).

Recommended:

Miles V. Klein and Thomas E. Furtak, *Optics*, Wiley, New York, (1986), 2nd Edition

Robert F. Fischer and Bijana Tadic, *Optical System Design*, McGraw-Hill Professional, New York, (2000).

Warren J. Smith, *Modern Optical Engineering*, SPIE Press, Bellingham, Washington, (2000).

Rudolf Kingslake, *Optical System Design*, Academic Press, New York, (1983).

Robert W. Wood, *Physical Optics*, The Macmillan Company, New York, (1914).

Robert W. Wood, *Physical Optics*, 3rd Edition Optical Society of America, Washington, DC, (1988).

Course Calendar

7 January, 2019 (Monday)	First Day of Classes
9 January, 2019 (Wednesday)	First Day of EE 642 Class
21 January, 2019 (Monday)	Martin Luther King, Jr. Day (University Holiday)
25 January, 2019 (Friday)	Last Day to Register and Add Classes
25 January, 2019 (Friday)	Last Day to Drop Without a "W" (With Tuition Refund)
25 January, 2019 (Friday)	Last Day to Change Enrollment Option: (Pass/No Pass or Audit)
6 February, 2019 (Wednesday)	Term Project Problem Statements Due
18 February, 2019 (Monday)	Presidents' Day (University Holiday)
20 February, 2019 (Wednesday)	Revised Term Project Problem Statements Due
22 February, 2019 (Friday)	Last Day to Drop Without a "W" (Without Tuition Refund)
10–17 March, 2019	Spring Recess
29 March, 2019 (Friday)	Ph.D. Thesis Submission
5 April, 2019 (Friday)	Last Day to Drop With a "W"
24 April, 2019 (Wednesday)	Last Day of EE 642 Class
26 April, 2019 (Friday)	Spring Semester Classes End
26 April, 2019 (Friday)	EE 642 Project Presentations
27 April, 2019 (Saturday)	EE 642 Project Presentations
28 April, 2019 (Sunday)	EE 642 Project Presentations
27 April – 30 April, 2019	Stop Period (Study Days)
1 – 8 May, 2019	Final Examination Period

10 May, 2019 (Friday)	Term Projects Due, 9:00 p.m.
10 May, 2019 (Friday)	Commencement