Course Summary

Abstract

This course on contemporary issues in optics and photonics is designed to be a principal 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 599 Contemporary Issues in Optics and Photonics) extends the understanding of fundamental optical principles and the analysis of optical systems to include current areas of intense research in both optics and photonics, with a focus on their current status, future potential, and unresolved issues. Emphasis will be placed throughout on a balanced combination of fundamental principles and practical device and system design considerations.

Topics typically covered in EE 599 include: Optical systems design, nanotechnology in optics and photonics, photonic crystals, the integration of silicon VLSI electronics with photonic technology, silicon photonics as applied to optical fiber communication systems, organic light emitting diode displays, advanced solar cells, vertical cavity surface emitting lasers, negative index of refraction materials, quantum entanglement, biophotonics, and nonlinear optics.

A related course (EE 642 Advanced Geometrical Optics) further 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 once again placed throughout on a balanced combination of fundamental principles and practical system design considerations.

Topics typically covered in EE 642 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 (based on a phasor approach), 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 Advanced Geometrical Optics, 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

Dr. Armand R. Tanguay, Jr.
Professor
Electrical Engineering, Chemical Engineering and Materials Science, Biomedical Engineering, Ophthalmology, and Physics and Astronomy; Program in Neuroscience; Biomimetic MicroElectronic Systems Center (A National Science Foundation Engineering Research Center); Center for Photonic Technology, Center for Neural Engineering, and Signal and Image Processing Institute

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By appointment

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 599 Course Website

https://blackboard.usc.edu

Senior Teaching Fellows

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Course Requirements

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 599. 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. Alternatively, a substantive review of one or more current breakthrough papers in optics and photonics within the range of topics covered by the course may be pursued, with a focus on key issues.

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.

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 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, 15%
- Term Project (Paper), 45%
- Oral Presentation of Term Project, 40%

Course Textbooks


Course Calendar

12 January, 2014 (Monday)  First Day of Classes
14 January, 2014 (Wednesday)  First Day of EE 599 Class
19 January, 2014 (Monday)  Martin Luther King, Jr. Day
                            (University Holiday)
30 January, 2014 (Friday)  Last Day to Register and Add Classes
30 January, 2014 (Friday)  Last Day to Drop Without a "W"
30 January, 2014 (Friday)  Last Day to Change Enrollment Option:
                            (Pass/No Pass or Audit)
11 February, 2014 (Wednesday)  Term Project Problem Statements Due
16 February, 2014 (Monday)  Presidents' Day
                            (University Holiday)
25 February, 2014 (Wednesday)  Revised Term Project Problem
                                Statements Due
16–21 March, 2014  Spring Recess
1 April, 2014 (Wednesday)  Ph.D. Thesis Submission
10 April, 2014 (Friday)  Last Day to Drop With a "W"
29 April, 2014 (Wednesday)  Last Day of EE 599 Class
1 May, 2014 (Friday)  Spring Semester Classes End
                       EE 599 Project Presentations
2 May, 2014 (Saturday)  EE 599 Project Presentations
3 May, 2014 (Sunday)  EE 599 Project Presentations
2 May – 5 May, 2014  Stop Period (Study Days)
6 – 13 May, 2014  Final Examination Period
15 May, 2014 (Friday)  Term Projects Due, 9:00 p.m.
15 May, 2014 (Friday)  Commencement
## Tentative Weekly Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>14 January, 2015</td>
<td>Contemporary issues in optics and photonics</td>
</tr>
<tr>
<td>21 January, 2015</td>
<td>Optical systems design</td>
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<tr>
<td>28 January, 2015</td>
<td>Introduction to CODE V</td>
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<tr>
<td>4 February, 2015</td>
<td>Nanotechnology in optics and photonics</td>
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<tr>
<td>11 February, 2015</td>
<td>Photonic crystals</td>
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<tr>
<td>18 February, 2015</td>
<td>Vertical cavity surface emitting lasers</td>
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<tr>
<td>25 February, 2015</td>
<td>Integration of silicon VLSI electronics with photonic technology</td>
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<tr>
<td>4 March, 2015</td>
<td>Silicon photonics as applied to optical fiber communication systems</td>
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<tr>
<td>11 March, 2015</td>
<td>Organic light emitting diode displays</td>
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<tr>
<td>18 March, 2015</td>
<td>Spring recess</td>
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<tr>
<td>25 March, 2015</td>
<td>Advanced solar cells</td>
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<td>1 April, 2015</td>
<td>Negative index of refraction materials</td>
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<td>8 April, 2015</td>
<td>Quantum entanglement</td>
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<tr>
<td>15 April, 2015</td>
<td>Biophotonics</td>
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<tr>
<td>22 April, 2015</td>
<td>Nonlinear optics</td>
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<tr>
<td>29 April, 2015</td>
<td>Art of scientific presentations</td>
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Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/ or to the Department of Public Safety http://capsnet.usc.edu/department/public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu/ describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute (http://dornsife.usc.edu/ali), which sponsors courses and workshops specifically for international graduate students.

The Office of Disability Services and Programs (http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information (http://emergency.usc.edu) will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.