EE134, Introduction to Photonics (4 units)[1]

Prof. A.K. Ellerbee
ellerbee@stanford.edu
Phone: 725-4842
207 Nano Building

LECTURES:	M, W, F 10:00-10:50 AM, Ctr. for Nanoscale Sci & Tech. 143
LABORATORY:	Tuesday 7:00-10:00 PM, Packard 066
OFFICE HOURS:	Wednesday, 4-5:30pm
TEACHING ASSISTANT:	Hee Yoon Lee (lhy2090@stanford.edu)
TA OFFICE HOURS:	Thursday, 4-6pm
TEXTBOOK:	Fundamentals of Photonics, 2nd edition B.E.A. Saleh and M.C. Teich, 2007 First ed. available electronically through SULAIR: http://www3.interscience.wiley.com/cgi-bin/homepage/?isbn=9780471213741
GRADED ELEMENTS:	Participation (5%), Lab preparation (5%), Lab reports (20%), Homework (20%), Midterm (20%), Project (30%)
COURSE WEBSITE:	Coursework Page

PREREQUISITES**:** Introductory electromagnetism (exposure to Maxwell's equations and electromagnetic waves; PHYSICS 43 or equivalent) and vector calculus (MATH 51/52 or equivalent). Previous experience with optics, plane waves, and optoelectronic devices by way of EE41 or an equivalent is helpful but not required.

Welcome!

This class provides an opportunity for students interested in optics and photonics to learn the principles that govern the generation, manipulation, and detection of light and to obtain hands-on experience applying these principles to analyze and design working optical systems in the laboratory. The concepts we will cover form the basis for the design and function of many devices and systems in biology, medicine, and telecommunications. Connecting theory to observation and application will be a major theme for the course. In particular, this course will also make frequent reference to applications of interest in medicine and biology.

STUDENTS WITH DOCUMENTED DISABILITIES. Students seeking academic accommodation based on the impact of a disability must initiate the request as soon as possible with the Student Disability Resource Center (SDRC) located within the Office of Accessible Education (OAE). SDRC staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. The OAE is located at 563 Salvatierra Walk (phone 650-723-1066, TTY 650-723-1067, fax 650-725-5301).

[1] Portions of the lectures, exercises, handouts, and overall design of EE 134 were authored by Matthew Lew for CTL 312: Science and Engineering Course Design, Winter 2012.

LEARNING OBJECTIVES. With active engagement and completion of the course assignments, laboratory exercises, and design project, you will:

1) Recognize, compare, and contrast different theories of modeling light, including ray optics, wave optics, and electromagnetic optics.
2) Practice applying the aforementioned models to analyze the behavior and performance of various optical systems and devices.
3) Use and become familiar with equipment and components commonly found in optical laboratories.
4) Become exposed to various optical systems used in modern biology, medicine, and telecommunications and engage the fundamental physical principles that govern their function and design.
5) Practice formatting and presenting experimental work according to the norms of the field: writing abstracts, preparing journal or conference articles, and giving poster presentations.
6) Design, assemble, and evaluate an optical system that satisfies a specific set of performance criteria as a capstone project.

GRADED DELIVERABLES.

CLASS PARTICIPATION: You are expected to attend lectures. Lecture time will include an opportunity to engage with the material through various exercises intended to motivate and/or allow you to practice applying the concepts to real-world examples.

HOMEWORK: Due on Fridays in class. Late homework is not accepted.

MIDTERM: One-hour, in-class exam.

LAB PREPARATIONS: Due Tuesdays, at the beginning of the lab session.

LAB REPORTS: Due at the start of the lab the week following completion of the lab. Only one submission per group per lab; work should be shared amongst team members

PROJECT: Final write-up (poster) due at the end of the quarter; one per project team. Project suggestions and design requirements will be given to you mid-quarter. You will summarize and analyze your system and its performance in the form of a poster presentation to which you will be able to invite your friends.

JOURNAL CLUB: You will read a recent scientific paper or article that describes an optical device or system that uses the concepts discussed in lecture and is related to your project of interest. You will then create a short presentation to teach your classmates about the work described as well as comment and critique the article itself. Guidelines for this exercise will be given in class. This assignment will count towards an individual component of the your grade for the project.

COURSE PLAN. The first half of the quarter will cover fundamental optical concepts and theories; the second part will focus on optical components and systems. Topics covered in the first half are critical for modeling imaging systems from microscopes for biology to telescopes for astronomy, as well as for understanding and inventing methods for short-distance optical communication on semiconductor chips and the technology that enables the Internet. The second half of the class will cover light sources and detectors. The lab work throughout the course will form an integral complement to the course and enable you to use the principles we have learned and practiced to design and test your own optical system.

Week	Date	Subject	Reading	LAB
1	4/2	Ray Optics (Lab: Laboratory practice and laser safety procedures; Polarization of light)	Ch. 1&6	Lab 1
2	4/9	Wave Optics (Lab: Projection imaging)	Ch. 2	Lab 2
3	4/16	Fourier Optics (Lab: Interference or diffraction)	Ch. 4	Lab 3
4	4/23	Waveguides and fibers (Lab: Interference / holography)	Ch. 7&8	Lab 4
5	4/30	EM Optics (Lab: fiber optics)	Ch. 5	Lab 5
6	5/7	Light sources, resonators (Lab: Connectors / splice)	Ch. 13-15	Lab 6
7	5/14	Detectors, optoelectronics **MIDTERM**	Ch. 18	Project
8	5/21	Journal club		Project
9	5/28	Microscopy, fiber optic communication	Ch. 24	Project
10	6/4	Photonic switching, coupling	Ch. 23	Project
11	6/11	**PROJECT REPORT DUE (Date subject to change)**		Project