Class Meeting: **T** 1:30-2:50 & **Th** 3:10-6pm	Email: haggard@bard.edu
Class Location: **T** Heg 300 & **Th** Heg 106	Office: Rose 112
Office Hours: **TBD**	Office Phone: (845) 758-7302

Course Description — From observing the cosmos to single cells, understanding optics is what has allowed us to visualize the unseen world. This laboratory course provides an overview of the theoretical techniques and experimental tools used to analyze light and its properties. The course will encompass three broad approaches to understanding the behavior of light, geometrical optics, wave optics, and quantum optics. Through the manipulation of light using lenses, polarizers, and single-photon detectors, students will learn the physics that underlies microscopes, spectrometers, lasers, modern telecommunication, and human vision.

Optics is also a wonderful microcosm reflecting much of the rest of physics: the techniques that we use to study the bending of light rays as they move through materials inspired related techniques in the advanced treatments of classical mechanics and the movement of particles through the curved spacetimes of general relativity; the wave theory of optics gives concrete examples of the interference and diffraction phenomena that are ubiquitous in a much more abstract quantum theory; evanescent waves in optics even give a precise analog for the remarkable possibility of quantum tunneling through barriers. The conceptual foundations that you lay in this class will be useful to your throughout your studies of the physical world. The fact that this conceptual richness permeates one of the most technologically applicable areas within physics is a delight!

Text: *Optics*, by E. Hecht (Pearson, 2016)

Take home — This will be an unlimited time, open-book exam. You can study as much as you like using any resource up to opening the exam. However, once you have opened the exam only refer to your class notes and our primary text. I ask that you honor your peers and the effort that we all put into the class by not referencing any outside materials.

Grading Structure

Weekly Homework & Lab (due on Th)	30%
Guest lecture	10%
Attendance	5%
Quizzes	5%
Lab Project	10%
In-class exam	20%
Take home exam	20%

Homework — There will be homework due every Friday at 5pm. Complete solutions will be posted. I will grade a portion of the problems on a 0-5 scale. These scores mean roughly the following: 5=clear and complete solution, 4=good solution missing one conceptual point or calculation, 3=clear attempt but with substantive flaw, 2=effort made but incomplete plan, 1=little effort, 0=nothing appearing. I care most about the effort you invest and you can receive credit on this basis. The goal of the homework is for us to engage each other in a discussion of physics regularly, please come and visit as often as you like to discuss. Along these lines, I recommend that you work together; this is invaluable in learning physics. Please write things up yourself to show me and you that you understand it (this helps battle the illusion of explanatory depth, which is worth looking up). Please do not use the internet as a resource for anything but physics books.

Lab Projects — For a variety of reasons we are not able to run this course as a full lab course this semester. The idea of the lab project is to supplement your lab experience by setting up and performing an optics lab of your own choice. You will want to become familiar with the equipment that we have in the optics lab to help in guiding your choice. Ideally, the experiment you work on setting up could then be run by the other students in the course. That said, this will not be part of the grading criterion for the project because there is always uncertainty in taking on a new project.

Course website: `http://bohr.physics.berkeley.edu/hal/teaching/phys230Sp17/`

Week	Topics	Chap.
1/30	Geometric Propagation of Light: Huygen's & Fermat's Principles	4.1-4.5
2/6	Geometrical Optics: Lens, Mirrors, and Optical Systems	5
2/13	Geometrical Optics: Analytic Ray Tracing and Aberration	5 & 6
2/20	Wave Theory and Electromagnetic Waves	2 & 3
2/27	Interference and Wave Optics	9
3/6	Polarization	8
3/13	Diffraction: Fraunhofer Far Field Theory	10
3/20	**Spring Recess**	
3/27	Diffraction: Fresnel Near-Field Theory	10
4/3	Superposition of Waves and Wave Packets	7
4/10	Fourier Optics and Image Formation	11
4/17	Partial Coherence	12
4/24	Quantum Mechanics, Photons, and Mach-Zehnder Interferometry	
5/1	(**Advising days 5/2 & 5/3**) Lasers	
5/8	Photon Statistics	
5/15	Entangled Photons *Completion days 5/17-5/23*	

Note: I reserve the right to adjust this syllabus during the semester

Quizzes — Sporadic brief (10-15min) quizzes will help you keep track of what you should know and the few equations you should memorize.

Lateness and Other Anomalies — I will usually grade your homework over the weekend and return it to you in class on Monday. Late work will be accepted before I have graded that week's assignment with a 20% deduction on the graded score. After a set has been graded I will no longer accept late work. If you tell me about something ahead of time, almost any situation can be accommodated.

Further recommended books: Our class text is all you will need for this course, but if you would like to explore these topics in more depth here are some other books and reference manuals.

Introduction to Optics, by F. L. Pedrotti, L. M. Pedrotti, & L. S. Pedrotti
Another frequent choice for the textbook for a course at this level, you could go to this book for an alternative explanation of anything that you find unclear in Hecht.

Introduction to Modern Optics, by G. R. Fowles
An inexpensive Dover publication, this book is less comprehensive than Hecht or Pedrotti et al, but will give you the basics.

Principles of Optics, by M. Born & E. Wolf
The standard reference text for classical optics cited in the literature. They start from Maxwell's equations and derive all of classical optics. This text is at a more advanced level than our course.

Linear Systems, Fourier Transforms, and Optics, by J. D. Gaskill
A detailed and introductory book on the mathematics of Fourier transforms and their applications to optics, particularly image formation.

Introduction to Fourier Optics, by J. W. Goodman
Celebrated for its writing and clear explanations this more advanced book on Fourier optics is a classic.

Quantum Optics: An Introduction, by M. Fox
A nice stand-alone introduction to quantum optics written specifically for undergraduates.

I have read over this syllabus. I agree not to look at solutions manuals or use the internet for anything other than looking up reference information. Finally, I commit to stick to the parameters of the take home exams.

Signed: Date: