

*COURSE SYLLABUS
PHYSICS 415: OPTICS*

Light “is nothing other than a certain motion or action conceived in a very subtle matter, which fills the pores of all other bodies...”

[Rene Descartes, *La Dioptrique* (1637)]

“I procured me a Triangular glass-Prisme to try therewith the celebrated Pheaeenomena of Colours.”

[Isaac Newton, *Opticks* (1704)]

Light is an “an electromagnetic disturbance in the form of waves...”

[James Clerck Maxwell, circa 1870]

“The energy in a beam of light emanating from a point source is not distributed continuously over larger and larger volumes of space but consists of a finite number of energy quanta, ...”

[Albert Einstein, circa 1905]

“In the new setting of ideas the distinction [between particles and waves] has vanished, because it was discovered that all particles have also wave properties, and vice versa. Neither of the two concepts must be discarded, they must be amalgamated. Which aspect obtrudes itself depends not on the physical object, but on the experimental device set up to examine it.”

[Erwin C. Schroedinger, *Science Theory and Man* (1957)]

Description:

A study of electromagnetic radiation, with emphasis on the visible portion of the spectrum. Topics include optical detectors, superposition of waves, interference, far-field and near-field diffraction, polarization, waveguides and optical fibers, and nonlinear optical effects. Prerequisites: PHYS 252 and MATH 232. *One semester; three credits*

Text:

Pedrotti³, [Introduction to Optics](#) (3rd ed.)

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Office Hours:

I will announce office hours in class. Feel free to check to see if I am in at other times as well.

Goals:

1. To gain an understanding of the basic principles of the physical optics model of light.
2. To gain a certain level of mastery using these principles to explain certain optical phenomena.
3. To learn about some applications of these phenomena in the design and use of optical instruments.
4. To improve your mathematical skill and your analytic reasoning skill, which are both needed to be a successful physicist.
5. To deepen your appreciation of Nature.

Topic Prerequisites:

- introductory exposure to optics (Physics III level)
- 3-dimensional calculus and geometry
- complex representation of sine & cosine (Euler's Formula)
- basic differential equations

Outline:

We will discuss the following topics, some in greater detail than others. Chapter numbers from the text are included in parentheses as a reference.

Light and Its Detection	(1, 17)	Polarization	(14,15,23)
Geometric Optics	(2)	Diffraction	(11,12,13)
Mathematics of Waves	(4)	Nonlinear Optics	(24)
Interference	(5,7,8)	Waveguides & Fiber Optics	(10)

Grading:

There will be 2 tests during the semester, one around midterm and one near the end of the semester. There will be a comprehensive final exam. Each test will contribute 15% to your final grade and the final exam will contribute 20%. The remaining 50% of your grade will come from collected homework problems. Your final grade will be determined using the following scale:

$$0-59.9\% \Rightarrow F / 60-69.9\% \Rightarrow D / 70-79.9\% \Rightarrow C / 80-89.9\% \Rightarrow B / 90-100\% \Rightarrow A$$

Homework

Collected homework problems will usually be due one week after they are assigned. Each problem is worth 10 points. Late problems will be accepted with a 1-point penalty per day. After 5 days, the penalty will not increase beyond 5 points and problems can be turned in up until the last day of classes. I will simply divide your homework point total by the maximum possible total to get a percentage. Fifty percent of this percentage will count to your final percentage as described above. Other problems will be assigned but not collected. Refer to the problem outline to see a listing of problems.

Absences:

Let me know beforehand if you are going to miss a test so that other arrangements can be made. If you miss a test without warning, a make-up test can be taken with a 20% penalty.