University of Wisconsin – Stevens Point

Department of Physics and Astronomy

Optics – PHYS 385

Fall 2022

Course Information

- **Course title:** Optics
- **Course number:** PHYS 385
- **Pre-requisites:** PHYS 250 or consent of the instructor.
- **Textbook:** *Optics*, Eugene Hecht, Fifth edition, Pearson, ISBN 0-133-97722-6.
- **Instructor:** Maryam Farzaneh
- **Contact:** B105 Science Building, mfarzane@uwsp.edu
- **Office (Student) hours:** MWF: 10:00 – 11:00 am
  T: 1:00 – 2:00 pm

  If you cannot make any of the above office hours, **please know that I have an open-door policy. Please stop by as often as you wish or make an appointment by emailing me**.
- **Class times:**

  - **Lectures:** Monday & Wednesday, 1:00 – 1:50 pm, SCI-A113
  - **Laboratory:** Thursday, 11:00 am – 1:50 pm, SCI-B212

Required Material

- **Calculator:** Please have a scientific calculator handy. A cell phone is *not* a scientific calculator.
- **Lab Notebook:** Please purchase a quad-ruled Graph Paper Notebook (11× 8 1/2) to use as your lab notebook. If you already have a lab notebook that you have used before, you may use it for this course, provided enough blank pages are left in the notebook.

Course Description and Objectives

This course will introduce you to the basics of modern optics, primarily wave optics. You will learn to represent 1D waves and 3D electromagnetic waves mathematically. You will use this representation to study optical phenomena such as reflection, refraction, interference, diffraction, and polarization. We will also explore some of the many important applications of optical phenomena such as interferometry,

Fourier optics and lasers. You will get a chance to acquire lab skills in the optics lab and learn to write a clear lab report.

Course Objectives

1. Understand the mathematical representations of waves and wave interference.
2. Understand polarization mathematically and learn its practical applications.
3. Understand optical principles behind modern optical technologies and some experimental techniques such as interferometry and spectroscopy.
4. Learn to set up and align an optics experiment and use data and uncertainty analysis to reach a better understanding of the physics behind the experiment.
5. Learn to keep a lab notebook and write a clear, accurate lab report to communicate your results.

Lecture participation
I strongly encourage you to attend *all* the lectures and take detailed notes. Sometimes the lecture covers more material than you might find in your textbook. However, the only way to master an upper-level subject in physics is to read the text carefully (more than once) and consult other books and not solely rely on your class notes.

Homework
There will be one homework set per week, which is due at the beginning of the class period on the day indicated on the assignment. The solution to most of the homework problems should follow a logical step-by step approach. You should use brief sentences to describe which concepts you are using, write down any equations you are using and justify any approximation. The numerical answers should have a unit and a brief description of why it makes sense physically**.** I will post the solutions to the entire homework assignment on Canvas right after all homework assignments are submitted. **If you need an extra day or two to finish your homework, please let me know. I generally grant extensions. However, I do not accept assignments which are unreasonably late, unless you have talked to me about the situation in advance.** *Homework counts for 20% of your final grade.*

Laboratory
Ten lab activities are planned for this course. You will do the experiments with one or two partners, but every student should write an *individual* lab report. You will also need to keep good lab notebooks throughout the course. These notebooks will be graded. The lab reports are due one week after completion of the lab activity. Please refer to the **PHYS 385 Lab Guidelines** for information on how to write a report, how to keep a lab notebook and the breakdown of the lab grade. Your lab grade will depend on your lab report, lab notebook, pre-lab quiz and your performance in the laboratory. *Laboratory counts for 20% of your final grade.*

Exams
There will be *two* midterm exams during the semester, not counting your final exam. These exams will be held **during lab periods on weeks 5 and 10 (please see the course schedule)** and will be three-hour long. The final exam is non-cumulative, and is scheduled for **Wednesday, December 21, 8:00 – 10:00 am**. *Overall, these three exams count for 60% of your grade (20% for each exam).*

Grading and Evaluation

I will calculate your grade based on a weighted percentage of your scores as follows:

Homework	20%
Laboratory	20%
Exams (2 midterms, 1 Final)	60% (20% each exam)

Your final grades will be determined as follows:

93% and above	A	87--89%	B+	77--79%	C+	67--69%	D+
90--92%	A-	83--86%	B	73--76%	C	60--66%	D
		80--82%	B-	70--72%	C-	below 60%	F

Please note that I do *not* grade on a curve. Grades will be rounded up. For example, 85.6% will become an 86% (A-), but 85.3% will remain a B+.

General Course Policies

- **Disability services**

  UWSP is committed to providing reasonable and appropriate accommodations to students with disabilities and temporary impairments. If you have a disability or acquire a condition during the semester where you need assistance, please contact the Disability Resource Center (DRC) located at 108 Collins Classroom Center (CCC) as soon as possible. DRC can be reached at 715-346-3365 or at drc@uwsp.edu.

- **Academic misconduct**

  As a student at UWSP, I expect you to be familiar with the Chapter 14 of the UWSP policy document on Academic Misconduct (especially Section 14.03) found here: https://www3.uwsp.edu/dos/Pages/Student-Conduct.aspx.

  Simply put, ***do not*** copy each other's homework, lab reports and exams and pass them off as your own. Any confirmed incidence of academic misconduct, including plagiarism and other forms of cheating will be treated seriously and in accordance with the University policy.

- The schedule for the final exam is set by the University. I will not schedule an early final exam for whatever reason.

- **I *do not* assign work for extra credit. There are *no* bonus points that you can earn.**

- Once you hand in your final exam, there is nothing more you can do to change your grade.

Tentative Course Schedule

The tentative course schedule is as follows. This might change, and I will try my best to announce any changes beforehand. G1, G2, G3 indicate Lab Groups 1, 2 and 3 (assuming there are three groups).

Week	Chapter and Topic	Lab
(1)	(2) Introduction, waves in 1D	G1, G2, G3: Intro and Uncertainty Analysis
(2)	(2) Complex representation, Plane waves, (3) E&M waves, Wave equation	G1, G2, G3: Corrective Optics
(3)	(3) E&M wave example, Energy, Irradiance (4) Reflection, Refraction	G1: Gaussian Beams G2: Prism Spectrometer G3: Speed of Light
(4)	(4) Fresnel equations, Intensities	G1: Prism Spectrometer G2: Speed of Light G3: Gaussian Beams
(5)	(4) Total internal reflection, Evanescent wave (9) Interference, Linear Superposition of waves	**Exam 1 in lab**
(6)	(9) Conditions for interference, Coherence Young's double slit experiment	G1: Speed of Light G2: Gaussian Beams G3: Prism Spectrometer
(7)	(9) Michelson Interferometer, Applications	G1: Nowton's Rings G2: Michelson Interferometer G3: Fabry-Perot Interferometer
(8)	(9) Multiple beam interference, Fabry-Perot interferometer, Fringe width	G1: Michelson Interferometer G2: Fabry-Perot Interferometer G3: Nowton's Rings

(9)	(9) Fabry-Perot spectroscopy, Resolution (10) Diffraction, Fraunhofer and Fresnel diffraction	G1: Fabry-Perot Interferometer G2: Newton's Rings G3: Michelson Interferometer
(10)	(10) Single slit diffraction, Double slit diffraction	**Exam 2 in lab**
(11)	(10) Diffraction by many slits, Circular aperture	G1: Fourier Optics G2: Polarization G3: No LAB
(12)	(10) Optical resolution, Diffraction Grating	**Thanksgiving Break, No LAB**
(13)	(8) Polarization: linear, circular, elliptical, Polarizers, Dichroism	G1: Polarization G2: NO LAB G3: Fourier Optics
(14)	(8) Birefringence, Polarization by scattering and reflection, Retarders, Waveplates	G1: NO LAB G2: Fourier Optics G3: Polarization
(15)	(13) The Laser, resonant cavity, Stimulated emission, Types of lasers	**NO LAB**
(16)	**Final Exam: Wednesday, December 21** **8:00 – 10:00 am** **SCI-A113**	