University of Wisconsin – Stevens Point

Department of Physics and Astronomy

Optics – PHYS 385

Fall 2018

Course Information

- **Course title:** Optics
- **Course number:** PHYS 385
- **Instructor:** Maryam Farzaneh
- **Contact:** B105 Science Building, x--2423, mfarzane@uwsp.edu
- **Office hours:** Tuesday: 10:00 – 11:00 am
  Wednesday, Thursday, Friday: 11:00 am– 12:00 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.
- **Pre-requisites:** PHYS 250, PHYS 300, Math 220, Math 222 (or consent of the instructor).
- **Class times:**

  - **Lectures (SCI- A107):** Tuesday & Thursday 1:00 – 1:50 pm
  - **Laboratory (SCI- C102):** Monday 9:00 – 11:50 am

Course Description

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 in order to communicate your results.

Required Material

- **Textbook:** *Optics*, Eugene Hecht, 4th edition, Addison Wesley, ISBN 0-8053-8566-5.
- **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.

Lecture participation and Quiz

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. To that effect, we will have a short (10-minute) quiz once a week **on Tuesdays**. In this quiz, you will be asked to explain a concept in words and solve a very short problem. Each quiz will have 10 points and the quiz grades count for 10% of your overall grade.

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 answer should have a unit and a brief description of why it makes sense physically. Please refer to **PHYS 385 Homework Guidelines** for more information. Homework counts for 20% of your final grade.

Laboratory

Eight lab activities are planned for this course. You will do all of 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 two-hour long. Each midterm counts for 15% of your grade. The final exam is scheduled for **Thursday, December 20, 12:30 – 2:30 pm**. It counts for 20% of your grade. Overall, your exams comprise 50% of your grade.

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 and Assistive Technology Center on the 6th floor of Albertson Hall (library) as soon as possible. DATC can be reached at 715-346-3365 or DATC@uwsp.edu.

- **Academic misconduct**

  As a student at UWSP, I expect you to be familiar with the following document: http://www3.uwsp.edu/stuaffairs/Documents/RightsRespons/SRR-2010/rightsChap14.pdf, especially Section 14.03. 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 University policy.

- Food and drinks are absolutely **not** permitted in the laboratory. No exceptions.

- **Since texting and cell phone use creates distraction both for me as your instructor and your classmates, texting and use of cell phone are not allowed in the classroom and in the laboratory. All cell phones should be turned off or silenced during the class and kept in your bag. No cell phone should remain in your pockets or on your desk. If I see a student texting in class, I will ask him/her to leave the classroom or the lab for the remainder of the class or lab period.**

- Make-up work will only be accepted in the case of excused absences. Excused absences include death in the immediate family, illness with a note from the appropriate health care professional, religious observance, an event in which you officially represent the UWSP and the event directly conflicts with an exam or lab. Excused absences must be approved with documenting materials prior to the date of absence. You should contact me in advance to inform me of your absence.

- If you are a student-athlete and encounter a time conflict with an exam because you have to be away for a sport competition, please make sure to approach me about the make-up exam in advance **with a note from your coach**.

- The schedule for the finals 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.

Grading and Evaluation

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

Homework	20%
Quiz	10%
Laboratory	20%
Exams (2 midterms, 15% each)	30%
Final exam	20%

Your final grades will be determined as follows:

90% and above	A	82--85%	B+	70--73%	C+	56--60%	D+
86--89%	A-	78--81%	B	66--69%	C	50--55%	D
		74--77%	B-	61--65%	C-	below 50%	F

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

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	Date	Chapter and Topic	Lab
(1)	Sept 4 (T) Sept 6 (R)	(2) Introduction, waves in 1D (2) Waves in 1D, contd.	**No Lab**
(2)	Sept 11 (T) Sept 13 (R)	(2) Complex representation, Plane waves (3) E&M waves, Wave equation	G1, G2, G3: Uncertainty Analysis
(3)	Sept 18 (T) Sept 20 (R)	(3) E&M wave example, Energy (3, 4) Irradiance, Reflection, Refraction	G1, G2, G3: Corrective Optics
(4)	Sept 25 (T) Sept 27 (R)	(4) Fresnel eqns. (4) Intensities	G1: Gaussian Beams G2: Prism Spectrometer G3: Speed of Light
(5)	Oct 2 (T) Oct 4 (R)	(4) Total internal reflection, Evanescent wave (9) Interference, Linear Superposition of waves	**Exam 1 in lab**

(6)	Oct 9 (T) Oct 11 (R)	(9) Conditions for interference (9) Coherence Young's double slit experiment	G1: Prism Spectrometer G2: Speed of Light G3: Gaussian Beams
(7)	Oct 16 (T) Oct 18 (R)	(9) Michelson Interferometer (9) Michelson Interferometer, Applications	G1: Speed of Light G2: Gaussian Beams G3: Prism Spectrometer
(8)	Oct 23 (T) Oct 25 (R)	(9) Multiple beam interference (9) Fabry-Perot interferometer, fringe width	G1, G2, G3: Holography
(9)	Oct 30 (T) Nov 1 (R)	(9) Fabry-Perot spectroscopy, Resolution (10) Diffraction, Fraunhofer and Fresnel diffraction	G1: Michelson Interferometer G2: Fabry-Perot Interferometer G3: Fourier Optics
(10)	Nov 6 (T) Nov 8 (R)	(10) Single slit diffraction (10) Double slit diffraction	**Exam 2 in lab**
(11)	Nov 13 (T) Nov 15 (R)	(10) Diffraction by many slits Circular aperture (10) Optical resolution	G1: Fabry-Perot Interferometer G2: Fourier Optics G3: Michelson Interferometer
(12)	Nov 20 (T) Nov 22 (R)	(10) Diffraction Grating **Thanksgiving Break, No Class**	G1: Fourier Optics G2: Michelson Interferometer G3: Fabry-Perot Interferometer
(13)	Nov 27 (T) Nov 29 (R)	(8) Polarization: linear, circular, elliptical (8) Polarizers, Dichroism	Problem Solving/lecture Room TBD, 9:00-9:50 am
(14)	Dec 4 (T) Dec 6 (R)	(8) Birefringence, Polarization by scattering and reflection (8) Retarders, Waveplates	Problem Solving/lecture Room TBD, 9:00-9:50 am

(15)	Dec 11 (T) Dec 13 (R)	(13) The Laser, resonant cavity (13) Stimulated emission, Types of lasers	Problem Solving/lecture Room TBD, 9:00-9:50 am
(16)		**Final Exam: Thursday, December 20** **12:30 – 2:30 pm** **A107-SCI**	