University of Wisconsin – Stevens Point

Dept. of Physics and Astronomy

Optics – PHYS 385

Fall 2016

Course Information

- **Course title:** Optics
- **Course number:** PHYS 385
- **Instructor:** Maryam Farzaneh
- **Contact:** B105 Science Building, x--2423, mfarzane@uwsp.edu
- **Office hours:** Wednesday: 10:00 am– 12:00 pm
  Thursday: 2:00 – 4:00 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.
- **Class times:**

  - **Lectures (SCI- A107):** Tuesday & Thursday 1:00 – 1:50 pm

  - **Laboratory (SCI- C102, A104):** Monday 10:00 am – 12:50 pm

Course Description

This course will introduce you to the basics of modern optics, primarily wave optics. You will learn to represent electromagnetic waves mathematically and use this representation to study optical phenomena such as reflection, refraction, interference, diffraction and polarization.

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.

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

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. We will also have group problem solving exercises during the class which will be graded as a part of your homework.

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 25% 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 25% 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 in 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 comprehensive and scheduled for **Wednesday, December 21, 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**
  Any student who has a disability and is in need of classroom and/or exam accommodations, please contact the instructor and the Disability& Assistive Technology Center (715-346-3365).

- **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 <u>kept in your bag</u>. 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.

- 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	25%
Laboratory	25%
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.

Week	Date	Chapter and Topic	Lab
(1)	Sept 6 (T) Sept 8 (R)	(2) Introduction, Uncertainty analysis reminder (2) Waves in 1D	**No Lab**
(2)	Sept 13 (T) Sept 15 (R)	(2) Complex representation, Plane waves (3) E&M waves, Wave equation	G1: Corrective Optics G2: Corrective Optics G3: Corrective Optics
(3)	Sept 20 (T) Sept 22 (R)	(3) E&M wave example, Energy, Irradiance (4) Reflection and Refraction, Fresnel Eqns.,	G1: Gaussian Beams G2: Prism Spectrometer G3: Speed of Light
(4)	Sept 27 (T) Sept 29 (R)	(4) Fresnel Eqns., Intensities (4) Total internal reflection, Evanescent wave	G1: Prism Spectrometer G2: Speed of Light G3: Gaussian Beams
(5)	Oct 4 (T) Oct 6 (R)	(9) Interference, Linear Superposition of waves (9) Conditions for interference, Coherence	**Exam 1 in lab**
(6)	Oct 11 (T) Oct 13 (R)	(9) Young's double slit experiment (9) Michelson Interferometer, Applications	G1: Speed of Light G2: Gaussian Beams G3: Prism Spectrometer
(7)	Oct 18 (T) Oct 20 (R)	(9) Multiple beam interference (9) Fabry-Perot interferometer	G1: Holography G2: Holography G3: Holography
(8)	Oct 25 (T) Oct 27 (R)	(9) Fabry-Perot spectroscopy, Resolution (9) Examples, Applications	G1: Michelson Interferometer G2: Fabry-Perot Interferometer G3: Fourier Optics

(9)	Nov 1 (T) Nov 3 (R)	(10) Diffraction, Fraunhofer and Fresnel diffraction (10) Single slit diffraction	G1: Fabry-Perot Interferometer G2: Fourier Optics G3: Michelson Interferometer
(10)	Nov 8 (T) Nov 10 (R)	(10) Double slit diffraction (10) Diffraction by many slits	**Exam 2 in lab**
(11)	Nov 15 (T) Nov 17 (R)	(10) Circular aperture, optical resolution (10) Diffraction Grating	G1: Fourier Optics G2: Michelson Interferometer G3: Fabry-Perot Interferometer
(12)	Nov 22 (T) Nov 24 (R)	(8) Polarization: linear, circular, elliptical **Thanksgiving Break, No Class**	Monday Lecture at 11:00, A104 (10) Fresnel diffraction patterns
(13)	Nov 29 (T) Dec 1 (R)	(8) Retarders, Compensators (8) Faraday effect, Kerr effect	Monday Lecture at 11:00, A104 (8) Polarizers, Dichroism
(14)	Dec 6 (T) Dec 8 (R)	(11) Fourier methods in diffraction theory (13) Image formation and Spatial filtering	Monday Lecture at 11:00, A104 (7) & (11) Fourier Transforms, Dirac delta function
(15)	Dec 13 (T) Dec 15 (R)	(13) The Laser (13) Gaussian laser beam, Types of lasers	Monday Lecture at 11:00, A104 (13) Stimulated emission
(16)		**Final Exam: Wednesday, December 21** **12:30 – 2:30 pm** **A 107**	