

PHY 410

Fall 2008

(as of August 18th, 2008)

Course Objective:

In this course, we will examine the fundamental phenomena associated with light. Focusing on both physical as well as geometrical optics, we will strive to obtain basic understanding of the properties of light and explore how they are applied in modern instrumentation. This course aims to develop a working knowledge of optics so that you are able to read and comprehend journal articles about optics as well as take part in a discussions focused on optics.

Topics that will be covered in this course are: geometrical optics, optical instrumentation, properties of waves, lasers, interference, coherence, and fiber optics. At the end of the semester, each student will give a presentation on a topic not covered in the course. In addition, the final evaluation will be an oral exam. Both of these activities stress a working knowledge of optics rather than rote memorization. Please prepare accordingly.

Prerequisites: PHY 140 or PHY 180 and MAT 162

Instructor Information:

Dr. Kevin Aptowicz
128 Boucher Laboratory
phone: 610.436.3010
kaptowicz@wcupa.edu

Office Hours:

Tu 7 am – 9 am & 3 pm – 4 pm
WF 11 am – 12 pm
or by appointment

Text:

Pedrotti³. 2007. *Introduction to Optics* (Third Edition). Upper Saddle River, NJ: Pearson Prentice Hall.

Grading: Two methods will be used to calculate each student's grade. The resulting highest grade will be the grade for the course.

Method #1

25% - Oral Final Exam
20% - Presentation
5% - Participation
15% - Exam #1
15% - Exam #2
20% - Homework

Method #2

30% - Oral Final Exam
20% - Presentation
5% - Participation
20% - Exam #1
20% - Exam #2
5% - Homework

Exams Policy:

There are no make-up exams. If you are going to miss an exam for a university excused absence (this requires a sign note) you must notify me one week before the exam is going to be offered. An alternate time to take the exam will be determined. This time would most likely be the day before the exam.

Problem Set Policy:

Problems at the end of each chapter will be used for the problem set. You are encouraged to attempt to solve the problems after reading the section. Problems will be chosen at random and graded to determine the score for the problem set. Solutions to all problems will be handed-out. It is your responsibility to check your work with the solution set.

Note that the problem sets should be viewed as a minimum assignment in the sense that if you encounter a difficulty with a particular idea, you may need additional practice with it by doing a few extra problems in the relevant section of the text.

LGBTQA Ally:

Based on West Chester University's commitment to diversity, I believe that everyone in my classroom should feel safe. I have completed the University's Lesbian, Gay, Bisexual, Transgender, Queer, Questioning Ally training. In becoming an ally I made the commitment to offer a safe space for *all* of my students, not just those who identify as LGBTQA. If you or someone you know would like to know more about this program, or needs to speak confidentially about issues of sexual orientation or gender identity, please feel free to see me during my office hours.

Disability:

We at West Chester wish to make accommodations for persons with disabilities. Please make your needs known by contacting the Office of Services for Students with Disabilities at extension 3217 as well as myself. Sufficient notice is needed in order to make the accommodations possible. The University and I desire to comply with the ADA of 1990.

Public Safety:

The Emergency Communication Committee has made the recommendation that the emergency phone number for WCU's Department of Public Safety be listed on all course syllabi. That number is 610-436-3311. This specific recommendation is made to help the campus be prepared in case of an emergency situation.

Tentative Schedule (might be revised as the semester progresses)

Lecture	Date	Day	Reading*
1	8-25-08	M	<ul style="list-style-type: none"> • 1-1: A Brief History • 1-2: Particles and Photons • 1-3: The Electromagnetic Spectrum • 1-4: Radiometry
2	8-27-08	W	<ul style="list-style-type: none"> • 2-1: Huygens' Principle • 2-2: Fermat's Principle • 2-3: Principle of Reversibility • 2-4: Reflections in Plane Mirrors • 2-5: Refraction Through Plane Surfaces
3	8-29-08	F	<ul style="list-style-type: none"> • 2:6: Imaging by an Optical System • 2-7: Reflection at a Spherical Surface • 2-8: Refraction at a Spherical Surface
	9-1-07	M	NO CLASS – Labor Day
4	9-3-08	W	<ul style="list-style-type: none"> • 2-9: Thin Lenses • 2-10: Vergence and Refractive Power • 2-11: Newtonian Equation for the Thin Lens • 2-12: Cylindrical Lenses
5	9-5-08	F	<ul style="list-style-type: none"> • 3-1: Stops, Pupils, and Windows
6	9-8-08	M	<ul style="list-style-type: none"> • 3-2: A Brief Look at Aberrations • 3-3: Prisms
7	9-10-08	W	<ul style="list-style-type: none"> • 3-4: The Camera • 3-5: Simple Magnifiers and Eyepieces
8	9-12-08	F	<ul style="list-style-type: none"> • 3-6: Microscopes • 3-7: Telescopes
9	9-15-08	M	<ul style="list-style-type: none"> • 4-1: One-Dimensional Wave Equation • 4-2: Harmonic Waves • 4-3: Complex Numbers
10	9-17-08	W	<ul style="list-style-type: none"> • 4-4: Harmonic Waves as Complex Functions • 4-5: Plane Waves • 4-6: Spherical Waves • 4-7: Other Harmonic Waveforms
11	9-19-08	F	<ul style="list-style-type: none"> • 4-8: Electromagnetic Waves • 4-9: Light Polarization • 4-10: Doppler Effect
12	9-22-08	M	Exam #1 – Chapters 1, 2, and 3,
13	9-24-08	W	<ul style="list-style-type: none"> • 5-1: Superposition Principle • 5-2: Superposition of Waves of the Same Frequency
14	9-26-08	F	<ul style="list-style-type: none"> • 5-3: Random Coherent Sources • 5-4: Standing Waves • 5-5: The Beat Phenomenon
15	9-29-08	M	<ul style="list-style-type: none"> • 5-6: Phase and Group Velocities
16	10-1-08	W	<ul style="list-style-type: none"> • 6-1: Energy Quantization in Light and Matter • 6-2: Thermal Equilibrium and Blackbody Radiation • 6-3: Nonlaser Sources of Electromagnetic Radiation
17	10-3-08	F	<ul style="list-style-type: none"> • 6-4: Einstein's Theory of Light and Matter • 6-5: Essential Elements of a Laser

18	10-6-08	M	<ul style="list-style-type: none"> • 6-6: Simplified Description of Laser Operation • 6-7: Characteristics of Laser Light • 6-8: Laser Types and Parameters
19	10-8-08	W	<ul style="list-style-type: none"> • 7-1: Two-Beam Interference
20	10-10-08	F	<ul style="list-style-type: none"> • 7-2: Young's Double-Slit Experiment • 7-3: Double-Slit Interference with Virtual Sources
	10-13-08	M	NO CLASS – Fall Break
21	10-15-08	W	<ul style="list-style-type: none"> • 7-4: Interference in Dielectric Films • 7-5: Fringes of Equal Thickness • 7-6: Newton's Rings
22	10-17-08	F	<ul style="list-style-type: none"> • 7-7: Film-Thickness Measurement by Interference • 7-8: Stokes Relations • 7-9: Multiple-Beam Interference in a Parallel Plate
23	10-20-08	M	<ul style="list-style-type: none"> • 8-1: The Michelson Interferometer • 8-2: Applications of the Michelson Interferometer • 8-3: Variations of the Michelson Interferometer
24	10-22-08	W	<ul style="list-style-type: none"> • 8-4: The Fabry-Perot Interferometer • 8-5: Fabry-Transmission: The Airy Function
25	10-24-08	F	<ul style="list-style-type: none"> • 8-6: Scanning Fabry-Perot Interferometer • 8-7: Variable-Input-Frequency Fabry-Perot Interferometers • 8-8: Lasers and the Fabry-Perot Cavity • 8-9: Fabry Perot Figures of Merit
26	10-27-08	M	Exam #2 – Chapters 4, 5, 6, and 7
27	10-29-08	W	<ul style="list-style-type: none"> • 9-1: Fourier Analysis • 9-2: Fourier Analysis of a Finite Harmonic Wave Train
28	10-31-08	F	<ul style="list-style-type: none"> • 9-3: Temporal Coherence and Line Width • 9-4: Partial Coherence
29	11-3-08	M	<ul style="list-style-type: none"> • Decide on Presentation Topic • 9-5: Spatial Coherence • 9-6: Spatial Coherence Width
30	11-5-08	W	<ul style="list-style-type: none"> • 11-1: Diffraction from a Single Slit • 11-2: Beam Spreading • 11-3: Rectangular and Circular Apertures
31	11-7-08	F	<ul style="list-style-type: none"> • 11-4: Resolution • 11-5: Double-Slit Diffraction • 11-6: Diffraction from Many Slits
32	11-10-08	M	<ul style="list-style-type: none"> • 13-1: Fresnel-Kirchhoff Diffraction Integral • 13-2: Criterion for Fresnel Diffraction • 13-3: The Obliquity Factor
33	11-12-08	W	<ul style="list-style-type: none"> • 13-4: Fresnel Diffraction from Circular Apertures • 13-5: Phase Shift of Diffracted Light • 13-6: Fresnel Zone Plate
34	11-14-08	F	<ul style="list-style-type: none"> • 16-1: Conventional versus Holographic Photography • 16-2: Hologram of a Point Source • 16-3: Hologram of an Extended Object • 16-4: Hologram Properties
35	11-17-08	M	<ul style="list-style-type: none"> • 21-1: Optical Imaging and Processing
36	11-19-08	W	<ul style="list-style-type: none"> • 21-2: Fourier-Transform Spectroscopy

37	11-21-08	F	• Holographic Magic!!!
38	11-24-08	M	• Presentations
	11-26-08	W	NO CLASS – Thanksgiving
	11-28-08	F	NO CLASS – Thanksgiving
39	12-1-08	M	• Presentations
40	12-3-08	W	• Presentations
41	12-5-08	F	• Presentations
42	12-8-08	M	• Presentations
	12-12-08	F	Oral Final Exam

***Complete reading before date indicated.**

Presentations

Purpose: The purpose of the presentation is to teach your fellow students about an interesting field or phenomenon in optics. You should plan on your presentation lasting about 12 minutes not including an additional 3 minutes for questions. You can use any format you like (chalk and talk, PowerPoint, etc).

Presentation Participation: Every student will be expected to ask questions during the presentation. Please try to ask at least one question at three different presentations.

Evaluation: Your presentation will be graded on how well you know the topic as well as make connections to ideas we have already discussed in class. With this in mind, limit your presentation to concepts that you have a firm grasp of. It is better to keep it simple, but know what you are talking about, than to discuss complex ideas that you don't totally understand. Be prepared for questions both from your fellow students and myself.

Choosing a Topic: All topics presented must be based on an article from *Optics & Photonics News* magazine. Choose only articles that have been published over the last two years. Please choose a topic that you have some interest in or you are curious about. Be careful not to choose a topic that is too challenging or based on ideas we have not covered in the course. You do not have to discuss the entire content of the article. When you have chosen a topic, run it by me and I'll help you determine whether it's appropriate. I will leave copies of *Optics & Photonics News* magazine in the student lounge for you to browse.

Finally, feel free to stop by my office if you run into any problems or you wish to iron out some ideas. Good luck!