**PHO K101 Introduction to Light and Lasers**

**3 Credits ( 5 class hours/week)**

Andy Finch

Email: [afinch@trcc.commnet.edu](mailto:afinch@trcc.commnet.edu)

**Course Description**:

In this course, will explore the nature of light, learn where light comes from and the units used to measure light, the laws of reflection and refraction and how these lead to image formation, the nature of waves, and the wavelike behavior of light. We will also investigate applications of light in nature and technology for every concept we study.

All concepts will be reinforced through regular homework assignments, demonstrations and computer simulations (including applets found on the internet.)

This is an “inquiry-based” course ­– there are hands-on activities nearly every class. Activities are completed in teams, which means that if you are absent you will miss a difficult-to-replicate educational experience- and you will let your team down.

I expect that, as with any job, you will notify me by email ([afinch@trcc.commnet.edu](mailto:afinch@trcc.commnet.edu)) or phone (860-970-9240) if you will not be in class (for a valid reason). You are responsible for arranging to make up what you have missed.

**Text:**

• ***LIGHT: Introduction to Photonics*** The bookstore will not carry this book, since it is from a printer, not a publisher. It is available at <http://www.lulu.com/shop/search.ep?contributorId=630411> as a pdf download, paperback or hardcover.

• There are some books that might be handy for reference (they may be found in the college library or the lab library in B207). These texts may be at a high math level.

* Pedrotti and Pedrotti, Introduction to Optics, Prentice Hall (requires advanced calculus)
* Wilson and Buffa, College Physics (or other high school of college physics text)
* Photonics Spectra and Laser Focus World (these are monthly trade journals you can subscribe to for free)
* Hecht, Optics , Addison Wesley (this also has calculus, but the drawings and photos are wonderful)
* ­­Videos The PHOTON Projects web site (<http://www.nebhe.org/programs-overview/photon/overview>) has videos of Judy Donnelly and friends doing some of the labs you will be doing in this course. Look under the “teaching resources” tab.

There are many online resources as well- check out <http://www.lasertechonline.org> for a list.

**Prerequisites/Corequisites:**

MAT K095 is a prerequisite (or instructor's permission). MAT K137(S) are corequisites. If you never had a course in chemistry or physics (or need a refresher) you should check out the tutorials on the web site, <http://www.lasertechonline.org>.

**Communications  
*I communicate only by email - So please check your email often.***

And while you’re at it- be sure you have a professional email for school and work use.

**PHO 101 Introduction to Photonics**

**Topic List**

Light sources

Electromagnetic spectrum

Production of light (atomic theory)

Characteristics of different types of light sources/radiometry and photometry

Geometric optics

Shadows and pinhole cameras

Law of reflection (plane mirrors, spherical mirrors)

Index of refraction (and other glass properties)

Law of refraction (index of refraction, total internal reflection, optical fiber)

Prisms (uses of prisms)

Lenses (converging, diverging, Lensmaker’s equation, thin lens equation for problems with one lens)

Optical Instruments using lenses (the eye, corrective lenses as time permits)

Wave Optics

Vibrations and Waves

Superposition/2-slit experiment

Holography and interferometry

Diffraction

Polarization

**Hands-on Experiments;** You will do a lab experiment in nearly every class. Ideally, you *will learn by doing and critically thinking about what you observe.* You will also participate in some group problem solving activities to strengthen you ability to work in a real-life technician situation.

**WHAT YOU’LL BE GRADED ON**

**Lab Reports**

Some labs will be informal and you will turn in a data sheet and calculations, and questions on your methods and results. Other labs will require a more complete analysis. You will be instructed on their details before each experiment begins. Some labs will just be checked (+ or -) and other labs will be graded out of 10 points. Lab due dates depend on the complexity of the lab. I hate grading late labs so if your lab is late you will lose points.

**Homework**

Homework will focus on material you will need to know for succeeding optics courses. Open-ended questions based on industry applications will also be included.

**Class Participation**

The class participation grade will depend first and foremost on attendance. I take attendance and mark late arrivals so being on time is important too. I may collect homework once in a while and use it toward the class participation grade. Occasional assignments, such as research on companies we may visit, will be graded and included in this category. Volunteering in outreach activities counts too!

**Final Exam**

This will be an open book exam, with questions similar to the homework

**Final grade**

Homework 40%

Class Participation/attendance 10%

1% for outreach program, -1% for unexcused absence

Final Exam 10%

Hands-on activities (labs) 40% (drop lowest grade)

**Cell phone policy**

***Cell phones must be turned off during class or lab activity time. Yes, this means you.* Multitasking does not work. Really.**

**Students with Disabilities**

If you have a disability that may affect your progress in this course, please meet with a Disability Service Provider (DSP) as soon as possible. Please note that accommodations cannot be provided until you provide written authorization from a DSP.

|  |  |
| --- | --- |
| **TRCC Disabilities Service Providers**  Counseling & Advising Office  Room A-119 | |
| **Matt Liscum**  (860) 383-5240 | Physical Disabilities  Sensory Disabilities  Medical Disabilities  Mental Health Disabilities |
| **Chris Scarborough**  (860) 892-5751 | Learning Disabilities  ADD/ADHD  Autism Spectrum |

**PHO 101 Introduction to Light and Lasers Outcomes**

Upon successful completion of this course, you will be able to:

1. Analyze interdisciplinary problems involving applications of light, propose and evaluate solutions.
2. Take, analyze and present data and draw conclusions about principles and applications of geometric and wave optics
3. Explain how light is absorbed and emitted using energy level diagrams.
4. Describe the spectral characteristics of light sources. In lab, determine the spectral content of light sources using an Ocean Optics spectrometer.
5. Place the electromagnetic and visible light spectra in order by wavelength and by frequency.
6. Use ray tracing to explain the formation of shadows and the operation of a pinhole camera and to solve plane mirror problems.
7. Explain the origin of refraction and solve problems using Snell’s law.
8. Decide which type of glass to use (given a table of glasses) for simple situations
9. Identify types of lenses by name, and explain the specifications for purchasing lenses (i.e., explain the headings in a catalog such as Edmund Scientific)
10. Predict the type and orientation of an image for a single lens and solve single lens problems by ray tracing and with the thin lens equation
11. Set up optical systems based on rails, including posts and post holders, lens holders, laser mounts
12. Set up breadboard based optical systems and perform a simple single beam optical alignment using a laser
13. Identify common optical mounts and components by name and use
14. Graph data using a computer application (such as Graphical Analysis) and use the built in functions to analyze the graph
15. Explain wave interference and the double slit experiment, explaining how fringe spacing changes with a change of wavelength or slit spacing.
16. In lab, use a diffraction grating to measure the wavelength of laser sources.
17. Identify near and far field diffraction patterns and explain the wavelength and geometry dependence of features such as the Airy disk
18. Provide examples of the application of Rayleigh’s criterion in art and technology
19. Explain how polarized light is created by polarizing filters and what happens when two such filters are rotated against each other.
20. Explain why the sky is blue and why the blue sky is polarized in terms of Rayleigh scattering