PHO 241 Introduction to Laser Technology 3 credits
PHO 242 Intro to Laser Technology Lab 1 credit

Spring 2014

A Finch

Course Description

This course is designed to introduce you to the basic principles of laser physics and technology and to provide you with a working knowledge of the various types of laser systems and their applications. Topics will include: properties of laser light, basic laser principles including stimulated and spontaneous emission, modification of the laser output, laser safety, and an exploration of the various laser types, laser accessories and their application to industry. Applications such as laser manufacturing and optical image processing will be included.

Pre requisites: PHO 101; or permission of the instructor
Co Requisites: PHO 242

Texts

- Instructors Notes and Handouts.
- *LIGHT –Introduction to Optics and Photonics* (Donnelly and Massa) – we'll use a few chapters
- An online textbook: *The Laser Adventure*, http://web.phys.ksu.edu/vqm/laserweb/
- **Recommended, but not required:** Hitz, Ewing and Hecht, *Introduction to Laser Technology, ed 4*. This book was written for company training and has a lot of nice, easy to understand analogies. There are some oversimplifications, but it's easy to read and understand- a good technician reference.
- Internet research- the best way to get up-to-date knowledge.
- *Laser Focus World* – This is a free trade magazine from Pennwell Press. If you subscribe please use your own address, not the college's.
- *LASERS (Siegman)* – All you ever would want to know about Lasers (advanced)

Attendance Policy

Students are expected to attend all classes, be on time and be prepared. If you must miss a class I expect you to call or email me so that your team can plan around your absence. In general, team assignments can't be made up but if you have a valid excuse for your absence an alternate assignment may be provided.
It is up to you to find out what you missed and make up assignments.

Quizzes, Homework, Paper: how the course works

The course is divided into 9 modules, each lasting about a week. Some more complex modules are two weeks. Each module begins with a list of outcomes (what you need to learn) and ends with a quiz. The topic of the module will be explored through reading, online applets and

simulations, discussion, examples and homework problems. Homework will be assigned on a regular basis but will not be collected. Each module will end with a quiz. Quizzes are based on homework problems so be sure you understand all the assigned problems.

The final assignment will be a short presentation (8-10 slides) on a specific laser. Details of the assignment will be provided in class. The presentations will be shared with the class including any online members.

The Lab Part

The best way to learn is by doing, so you will be doing short experiments, longer projects and problem-based learning (PBL) challenges. The course is structured with 1 evening session per week consisting of a taught class and lab section. The lab section is extremely important in the learning process. **You need to be present so as not to miss this.**

Most labs will result in some sort of report; the actual requirements will be given each time, including whether this is an individual or group report. In all cases, data, calculations and diagrams may be done (neatly!) by hand, but answers to questions must be typed.

COMMUNICATIONS

Class communications are by email. Please check your email frequently. I will not send text messages; email is still industry's method of communication - so embrace it. You have a TRCC email address as of this semester, so be sure to check it. (If you prefer I use another address, please let me know.) Also note: **Please turn off cell phones and pagers during class. Multitasking doesn't work.** ☺

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

Three Rivers Community College

TENTATIVE CALENDAR Spring 2014

Unit	Date	Topic	Additional Resources*
1	1/29-2/5	Atoms-Light Sources-Measurement	LIGHT Chapter 2 and Chapter 3
2	2/5-2/12	Light and Matter	LIGHT Chapter 9
3	2/12-2/19	Laser Physics (gain and loss)	
4	2/26-3/5	Output characteristics: Polarization and coherence	LIGHT Chapters 6 and 7
5	3/5-3/12	Output Characteristics: Wavelength Modes	LIGHT Chapter 9
6	3/26-4/2	Output Characteristics: Pulsed Lasers	
7	4/2-4/9	Output characteristics: Spatial modes	LIGHT Chapter 9
8	4/9-4/16	Output characteristics: Real beams	
9	4/16-5/2	Applications: Manufacturing, Image processing	
	5/7-5/9	Laser Types- Presentations	
	5/14	Cumulative quiz (counts as 2)	

* See also the Laser Adventure at http://perg.phys.ksu.edu/vqm/laserweb/

Possible tours:

TBD

Grade Breakdown

Quizzes (one will be dropped)	65 %
Laser presentation	10 %
Lab	25%

Outcomes

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

1. Explain the processes of spontaneous emission, stimulated emission, and absorption and describe the operation of 3 and 4 level lasers
2. Identify the required parts of a laser, and state the function of each, giving examples.
3. Trace the loop gain of a cw and a pulsed laser, identifying sources of loss and gain.
4. Identify cavity configurations and explain the pros and cons of each for various types of laser.
5. Explain the origin of longitudinal cavity modes and use the OSA and scanning FP interferometer to measure mode spacing.
6. Explain the origin of TEM modes and how TEM modes affect divergence and focusing. Explain the use of the “M-square”, “k” and “BPP” parameters to characterize laser output.
7. Design and build laser collimaters and spatially filter a laser beam.

8. Calculate divergence and spot size for a Gaussian beam and compare to higher order beam. Use the Spiricon Laser Beam Analyzer to illustrate TEM modes and to measure Gaussian beam diameter and beam divergence.
9. Explain the use of pulsed lasers to “repackage” energy. Calculate the peak power, average power and energy in a pulse. In lab, analyze energy and frequency of pulsed lasers.
10. Explain the operation of acousto-optic and electro-optic Q switches. Describe mode locking and explain the difference between Q-switched and mode-locked pulses.
11. Explain the source of non-linear effects and give examples of how these are used to create non-linear optical devices such as harmonic generators, optical parametric oscillators, etc.)
12. Describe considerations for choosing a particular laser or optical delivery system for a given material processing application. Use the laser engraver to illustrate the effects of changing focal length of a lens on cutting and engraving.