PHO 242 Introduction to Lasers Lab 1 credit
Spring 2014

Course Description

This is a required laboratory course to accompany PHO 241 for students earning the LFOT degree or certificate. Labs will include experiments in basic laser physics, laser applications and measurement of laser output parameters. Some labs will be problem based learning (PBL) exercises.

Pre requisites: PHO 101; or permission of the instructor
Co Requisites: PHO 241

Texts

- Instructors Notes and Handouts (There is no required text). If you need a book for reference, *Introduction to Laser Technology Ed. 4 (2012)* by Hitz, Ewing and Hecht is a good introductory text.
- Internet research- this is especially important for understanding laser instrumentation

Attendance Policy

Students are expected to attend all labs, be on time and be prepared. If you miss a lab you will be responsible for making up the work at a time that we are both available.

Lab Reports

Some labs will have brief written conclusions, others will be more formal. PBL exercises will require concept maps and reports. In some cases group reports will be accepted but you will also be responsible for turning in some individual reports on your own.

LATE WORK IS A REAL PAIN!! To minimize (my) pain, points will be deducted for work turned in past the due date. Work should be brought to the following week's class – but I strongly recommend that you complete the assigned work as early as possible while the experimental details are in your head.

TOPICS

Labs will be chosen from the list below. Due to limited instrumentation, groups will rotate among some of the experiments over a period of several weeks.

		Outcomes/students will explain, perform
absorption coefficient	Dependence of absorption on thickness and material	Power measurement, graph and interpret exponential curve, explain importance of medium absorption (and gain) to laser operation
photoelectric effect	Use PE to determine Work Function of a metal electrode	experimental methods (source/meter issues, zeroing meter), interpret graph and use slope to find unknown (Φ)

emission and absorption	Gas atomic emission and absorption by solids	Explain emission lines (gas) and absorption band (solid laser rod); use of USB spectrometer
Laser output characteristics		**Outcomes/students will explain, perform**
Spiricon Laser Beam Analyzer	Measure beam divergence	Use LBA to measure beam spatial parameters
OSA	Measure diode laser central wavelength and mode spacing	Use OSA to measure wavelength and power for FP and DFB lasers
Fabry-Perot Interferometer	Set up the FP interferometer and measure HeNe mode spacing.	How the FP interferometer is used to measure modes of a laser
Gaussian Beams (fiber probe)	Use an optical fiber to map a Gaussian beam profile	Gaussian beam profile, opto-mech: mounting fiber on translation stage
pulsed lasers	Measure pulse width and height and calculate energy and duty cycle for beam used with chopper	Use detector with oscilloscope, calibration of detector with power meter
Coherence length	Use Michelson Interferometer to measure coherence length	Importance of coherence length to interference phenomena
Spatial coherence	Use 2-slit set up to estimate spatial coherence for multimode HeNe lasers	Review 2-slit formula, explain spatial coherence as a function of beam profile
EDFA	Measure the effect of changing pump power and input signal power on laser output	Explain how gain varies using concept of population inversion
Alignment practice		**Outcomes/students will explain, perform**
Spatial filter	Alignment of a pinhole	Remove optical noise from HeNe beam
Expander/collimator Zygo lab II	Autocollimation/collimation tester Alignment with beam splitter	Telescopes to expand or shrink beams
Applications		
Bar code scanner	Read simulated bar code on rotating can	Alignment of source, object, detector; use of oscilloscope
Optical Image Processing	Build and experiment with a 4F optical image processing set up;	Alignment ; Study optical Fourier transforms and filters
Laser Material Processing	Effects of focal length, speed, power, frequency on engraving quality	Explain resolution and cut quality in terms of spot size and focal depth