CREOL
The College of Optics and Photonics
University of Central Florida

COURSE SYLLABUS

OSE 4520L: Laser Engineering Laboratory

Instructor: Dr. Patrick LiKamWa
Office: CREOL A211
Phone: 407-823-3816
E-Mail: patrick@creol.ucf.edu
Term: Spring 2020
Class Meeting Days: Thursdays
Class Meeting Times:
Section 0001: 8:00PM - 10:50AM
Section 0002: 12:00PM - 2:50PM
Class Location: CREOL A210
Office Hours: Wednesdays: 12:30 PM – 2:30 PM, or by appointment.
Website: https://webcourses.ucf.edu/courses/1343722

I. University Course Catalog Description

Experiments highlighting basic laser phenomena. The photon nature of light. Absorption and spontaneous and stimulated emission of light. Fluorescence. Optical amplifiers. Optical resonators. Lasers. Pulsed lasers. Nonlinear optical wave conversion.

II. Course Overview

This laboratory course is designed to give students hands-on experience in aligning, characterizing and analyzing lasers and generally understanding the principle of the laser. Students will work in small teams performing to build small lasers and laser systems in order to gain experience in building lasers, understanding the various types of output they can deliver and manipulating and applying laser beams. Through these experimental projects, students are introduced to most of the major concepts covered in the course, including the following: photons; emission; laser cavities and modes; laser threshold; laser beams, focusing and collimation; and second harmonic generation.

III. Course Learning Objectives

Upon completion of this course, the student will be able to:

1. Be able to align a basic laser cavity.
2. Know how to make a laser run on a single transverse mode
3. Be able to characterize a laser beam
4. Know how to measure laser power and determine laser irradiance
5. Explain the difference between single and multiple spatial modes lasers and know how to approach focusing and collimation in each case.
6. Be able to measure the spectral output of a laser.
7. Explain laser diode-pumping and second harmonic generation

IV. Course Prerequisites

Be currently enrolled in OSE 4520 Laser Engineering

V. Credits: 1 (3-0)

VI. Relationship of Course to ABET Criteria

ABET Criteria	Level of Emphasis During Course (Low, Medium, High)
(a) An ability to apply knowledge of mathematics, science, and engineering.	Medium
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.	High
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	Low
(d) An ability to function on multidisciplinary teams.	Low
(e) An ability to identify, formulate, and solve engineering problems.	High
(f) An understanding of professional and ethical responsibility.	High
(g) An ability to communicate effectively.	High
(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Low
(i) A recognition of the need for, and an ability to engage in life-long learning.	Low
(j) A knowledge of contemporary issues.	Low
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Medium

VII. Textbook:

Laser Engineering, Kelin J. Kuhn, Prentice Hall, (1998)

VIII. Recommended Reference:

Laser Fundamentals, W. Silfvast, Cambridge
Laser Electronics, 3rd ed., J. T. Verdeyen, Prentice-Hall, .
Fundamentals of Photonics, 2nd edition B. Saleh and M. Teich, Wiley, 2007

IX. Course Requirements

- The student is expected to review the textbooks, notes, and the lab handout; and come to lab prepared to perform the scheduled experiment.
- All experimental procedures, observations, data, and measurements during the laboratory session must be properly documented in the provided laboratory manual / handbook. All entries must be in ink. The lab manual / notebook will be collected at the end of each lab session.
- Each student is expected to maintain a three ring binder

X. Course Grading

Course Item	Percent of Final Grade
Laboratory Participation	15%
Lab Notebook Completeness	25%
Homework Assignments	35%
Draft Lab Report	5%
Final Lab Report	20%
	100

- Lab manuals / notebooks will be reviewed at the end of the class. If the instructor deems the work to be incomplete the student may be asked to stay and complete the work or a grade point will be deducted.
- The Lab reports (draft and final) must be submitted through Webcourses at http://webcourses.ucf.edu/ by 12:00AM of the day they are due.
- Lab reports sent via email or hard copy will NOT be accepted.
- Absences and Makeup Lab Sessions:
  - Because of the fluid nature of the lab with the experimental setup changing every week, there will be NO MAKEUPS ALLOWED except in cases of genuine emergency.
  - With prior arrangements, students may be allowed access to the lab after the class and before Friday at 3:00PM of the same week.
- The instructor reserves the right to change or modify any portion of this schedule without prior notice or recourse by the students.

XI. Guide for Preparing Lab Reports:

The objective of the lab is to understand fundamental concepts related to photonics, explore physical phenomena in a laboratory setting, make careful measurements, and draw your own conclusions about the models and theories that are supposed to describe these phenomena. The lab report should reflect these objectives.

Content:
The report should include the following sections (as appropriate):

Objective:	State purpose or objective of the lab session or experiment.
Theory:	Provide a brief summary (approximately one page) of concepts and relationships involved. Necessary equations or formulae are to be stated and referenced.
Experiment setup:	List equipment used with sketches where appropriate.
Procedure:	Summarize experimental procedure and measurement techniques.
Results:	Present raw data, calculations, numerical modeling of experimental results when appropriate.
Error Analysis:	Comment as to the magnitude and origin of uncertainty of the raw experimental measurements and discuss how these raw uncertainties propagate to affect the final calculated results. If data is suspect, discuss possible flaws in technique or measurements.
Discussion:	Discuss the specific topics provided at the beginning of lab description.
Conclusions:	Summarize results in a concise manner and state conclusions.

Format:

- The lab report must be in word or pdf format with type size 12 and one inch margins.
- The report must be informative and well organized with clearly labeled graphics and defined symbols.
- For additional information and tips, please see: Christopher S. Lobban & Maria Schefter, Successful Lab Reports: A Manual for Science Students (Cambridge: Cambridge University Press, 1992) or search the web with the quoted phrase “How to Write a Lab Report”.

Guidelines for lab notebook grading:

Item	**Score (%)**
Organization, neatness and readability of informal notes	25%
Correctness and presentation of results (Including, where appropriate, tables, plots, error analysis)	35%
Depth and conciseness of answers to Discussion and Analysis questions)	25%
Responses in complete sentences and paragraphs.	15%
Total	**100%**

XII. Financial Aid and Attendance

As of Fall 2014, all faculty members are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete the following academic activity by the end of the first week of classes, or as soon as possible after adding the course, but no later than August 27. Failure to do so will result in a delay in the disbursement of your financial aid.

XIII. Course Grading

Grading Scale (%)	**Rubric Description**
$100 \geq A > 93 \geq A^- > 90$	Excellent, has a strong understanding of all concepts and is able to apply the concepts in all and novel situations. Has full mastery of the content of the course.
$90 \geq B^+ > 87 \geq B > 83 \geq B^-$	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
$80 \geq C^+ > 77 \geq C > 73 \geq C^-$	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
$70 \geq D^+ > 67 \geq D > 63 \geq D^-$	Below average, has a basic understanding of only the simple concepts and is able to apply to only a limited number of the most basic situations.
$60 \geq F$	Demonstrates little to no understanding of the course content.

XIV. Grading Objections

All objections to grades should be made IN WRITING WITHIN ONE WEEK of the work in question. Objections made after this period has elapsed will NOT be considered – NO EXCEPTIONS.

XV. Class Website

Materials used for classes will be available on UCF Webcourses for download before each class. If you want a hard copy of the slides, print them. These are only printed for you for the first class.

You are required to read or view materials prior to class. If you do not, you will not be able to do well in this class.

XVI. Professionalism and Ethics

Academic dishonesty in any form will not be tolerated. If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule, the University of Central Florida's Student Handbook (http://www.goldenrule.sdes.ucf.edu/) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

It is the nature of a laboratory course that you will be working in groups. Obviously, those of you who are lab partners will be using the same raw data. You are encouraged to discuss your observations and insights with your lab partners; however, each of you has to write your own ORIGINAL lab reports.

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DEFINITIONS

Cheating: any unauthorized assistance in graded, for-credit assignments.
Plagiarism: appropriating the work of others and claiming, implicitly or explicitly, intentionally or unintentionally, that it is your own.

With increased use of the internet, digital plagiarism is becoming more of a problem on campuses everywhere. You are encouraged to use the internet; however, electronic copying and pasting of material directly into reports and papers without proper reference of the source is blatant plagiarism. ALWAYS REFERENCE THE SOURCES OF INFORMATION.

Providing a fellow student with experimental data from an experiment in which he/she did not participate is also forbidden. All parties that are involved in such practice will be reported to UCF Office of Student Conduct (OSC).

If there is any question concerning acceptable practice in this laboratory course, don't hesitate to ask the instructor.

XVII. Students with Special Testing/Learning Needs

Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at http://www.sds.sdes.ucf.edu/, or at (407) 823-2371.

XVIII. Excusal from Course Assignments and Course Examinations

If an emergency arises and a student cannot submit assigned work on or before the scheduled due date or cannot take an exam on the scheduled date, the student MUST give notification to the instructor NO LESS THAN 24 HOURS BEFORE the scheduled date and NO MORE THAN 48 HOURS AFTER the scheduled date.

XIX. Class Attendance and Participation

- Regular class attendance is mandatory.
- Please be on time to class with automatic loss of 5 grade points for >15 mins. tardiness.
- Students in attendance are expected to be active participants in the course.

Note: The instructor reserves the right to modify the information contained in this document at his discretion.

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COURSE SCHEDULE

Week	Day	Date	Topic
1	Thursday	Jan 9	Instructor Introduction; Course Overview (ALL)
2	Thursday	Jan 16	HeNe (Gas) Laser (Group A)
3	Thursday	Jan 23	HeNe (Gas) Laser (Group B)
4	Thursday	Jan 30	Diode Laser (Group A)
5	Thursday	Feb 6	Diode Laser (Group B)
6	Thursday	Feb 13	Spectroscopy of Nd:YAG crystal (Group A)
7	Thursday	Feb 20	Spectroscopy of Nd:YAG crystal (Group B)
8	Thursday	Feb 27	Diode Pumped Nd:YAG Laser (Group A)
9	Thursday	Mar 5	Diode Pumped Nd:YAG Laser (Group B)
10	Thursday	Mar 12	*Spring Break (No Class)*
11	Thursday	Mar 19	**Lecture (Instructions on Lab Report Requirements) (ALL)**
12	Thursday	Mar 26	Laser Pulses (Group A)
13	Thursday	Apr 2	Laser Pulses (Group B)
14	Thursday	Apr 9	Nonlinear Frequency Generation (Group A)
15	Thursday	Apr 16	Nonlinear Frequency Generation (Group B)
16	Friday	Apr 24	**(Final Report due by ALL)**

Note: The dates of the topics are subject to change depending upon how things progress during the course of the semester