Course Syllabus

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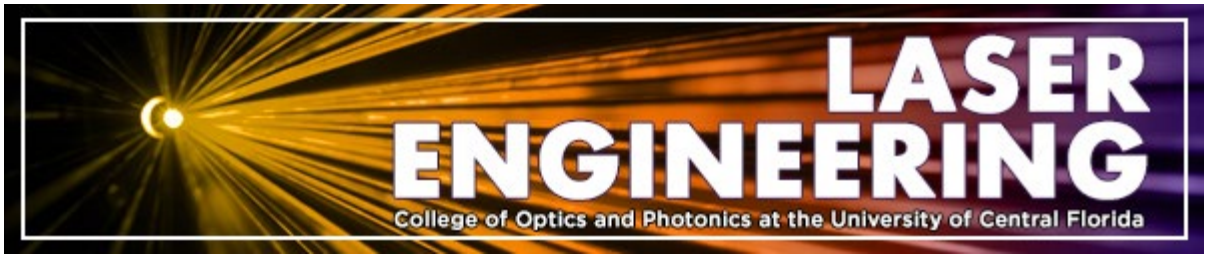

OSE 5525: Laser Engineering

CREOL, The College of Optics and Photonics

3 Credit Hours

Table of Contents

IMPORTANT: Regarding technical problems, please email Webcourses@ucf.edu.

Instructor Information

- Instructor: Dr. Axel SchülzgenLinks to an external site.
- Office Location: Room A115, CREOL Building
- Office Hours: Tuesday 1:00 - 3:00 p.m.

I will be in my office at these times, but of course I will be happy to discuss the material with you anytime. Often, I get questions via e-mail that can be quickly answered.

- Phone: 407-920 8509
- Digital Contact: axel@creol.ucf.edu or Webcourses@UCF messaging

Teaching Assistants

- GTA(s): TBD
- Email: TBD

Course Information

- Term: Fall Semester 2020
- Course Number & Section: OSE 5525
- Course Name: Laser Engineering
- Credit Hours: 3 Credit Hours
- Class Meeting Days: Monday/Wednesday
- Class Meeting Time: 10:30-11:45 a.m.
- Class Location: Online
- Course Modality: V

Enrollment Requirements

Course Prerequisites (if applicable): Graduate standing or consent of instructor
Course Co-requisites (if applicable): None
Other Enrollment Requirements (if applicable): None

Course Description

This course is titled “Laser Engineering” but could as well have been titled “Laser Principles”. It is an introductory course in lasers, so in fact there is more “Laser Principles” and little “Engineering” in it. The chief purpose is for students to obtain a solid understanding of the basic principles of lasers and to be familiar with the operation of most common laser types. The course is taught in the classical approximation, so a knowledge of quantum mechanics is not required.
This course is being taught to satisfy the requirements of the optics Ph.D. curriculum.

Course Materials and Resources

Required Materials/Resources

- “Principles of Lasers”, Orazio Svelto, 5th edition, (Springer)
  Reading assignments will be taken from this textbook.
- Computer with microsoft office and internet access
- Calculator

Optional Materials/Resources

- Other useful reference books:
  “Laser Electronics”, J. Verdeyen, (Prentice-Hall)
  “Laser Fundamentals” W. T. Silfvast, (Cambridge)
  “Lasers” A.E. Siegman
  “Optical Electronics in Modern Communications", 5th edition, A. Yariv, (Oxford)
  Almost any other text titled “…Lasers…” will probably provide insight on the topic.
- Smartphone with internet access

Third-Party Accessibility and Privacy Statements

The content of the course is limited to the students participating in the course. Regarding privacy we will follow the American Physical Society (APS) policy. For the terms of use, please visit the APS website (Links to an external site.).

Student Learning Outcomes

The primary learning outcomes are:
• To understand the laser idea and learn about the history of laser development and applications.
• To contrast properties of laser and thermal radiation.
• To become conversant with the Einstein treatment of absorption and emission.
• To describe absorption and emission line shapes and relate them to specific broadening mechanisms.
• To understand absorption saturation and explain resulting changes in the optical spectra.
• To demonstrate knowledge about the energy levels of atoms molecules and ions and to explain the resulting absorption and emission spectra.
• To describe laser media with rate equations, and to solve these.

• To calculate the lasing threshold and the continuous wave laser output powers for a set of given resonator parameters.
• To calculate how Gaussian beams propagate in free space and how they are focused.
• To determine stability of laser cavities and calculate Gaussian laser cavity modes.
• To distinguish between laser emission and amplified spontaneous emission.
• To understand possible laser pumping mechanisms and estimate their efficiencies
• To understand and calculate pulsed laser outputs.
• To calculate the minimum length of a laser pulse.
• To describe absorption and gain spectra of semiconductor structures.
• To be knowledgeable about the principles of operation of the most common laser types.

Course Activities

Most people learn things for themselves. As a teacher, my job is to help you learn the material. In order to help you learn in depth, I plan to use some class time for detailed discussion of concepts and group project work. Credit will be given for these activities. These types of activities require that students carry out reading assignments prior to

class. Hence, I will occasionally set quizzes to ensure that students come to class prepared. In addition, lectures will be posted here prior to the scheduled lecture time to allow students to create write their individual class notes during the lecture and/or prepare questions prior to the lecture.

In addition, homework will be assigned on a regular basis to help the students to accomplish the student learning outcomes. The homework will be graded to assess the students' progress in learning. Homework questions and solutions will be posted here. The major assessment of student learning outcomes will be two midterm exams and a final exam. In total, these exams will account for 75% of the grade.

To be prepared for class, submit your homework assignments, and study for the exams, students should plan on at least five hours' worth of work outside of class each week.

Activity Submissions

Assignments will be submitted electronically via email or through Webcourses@UCF submission. The pdf-file format is preferred. Other file formats can be accepted if the files can be easily opened and are readable.

Attendance/Participation

Because of the continued remote instruction requirement due to the COVID-19 pandemic, this course will use Zoom for synchronous ("real time") class meetings and review of recorded lectures. Meeting dates and times will be scheduled through Webcourses@UCF and should appear on your calendar.

Please take the time to familiarize yourself with Zoom by visiting the UCF Zoom Guides at <https://cdl.ucf.edu/support/webcourses/zoom/>. You may choose to use Zoom on your mobile device (phone or tablet).

Things to Know About Zoom:

- You must sign in to my Zoom session using your UCF NID and password.
- The Zoom sessions are recorded.
- Improper classroom behavior is not tolerated within Zoom sessions and may result in a referral to the Office of Student Conduct.
- You can contact Webcourses@UCF Support at <https://cdl.ucf.edu/support/webcourses/> if you have any technical issues accessing Zoom.

It is strongly encouraged to attend lectures at the scheduled time. However, this is not a strict requirement and the teacher can excuse your absence. Typically, this will be done by email. With prior approval, students will not be penalized for missing in class-activities such as group discussion or quizzes.

All students are expected to participate synchronously in the mid-term and final exams. Reasons for acceptable absences may include illness, serious family emergencies, military obligations, and severe weather conditions.

Make-up Exams and Assignments

Per university policy, you are allowed to submit make-up work (or an equivalent, alternate assignment) for authorized university-sponsored activities, religious observances, or legal obligations (such as jury duty). If this participation conflicts with your course assignments, I will offer a reasonable opportunity for you to complete missed assignments and/or exams. The make-up assignment and grading scale will be equivalent to the missed assignment and its grading scale. In the case of an authorized university activity, it is your responsibility to show me a signed copy of the Program Verification Form for which you will be absent, prior to the class in which the absence occurs. In any of these cases, please contact me ahead of time to notify me of upcoming needs.

Assessment and Grading Procedures

The table shows the weight distribution for each assignment.

Assignment	Percentage of Grade
In-class participation	10%
Quizzes	5%
Homework	15%
1st midterm exam	20%
2nd midterm exam	20%
Final exam	35%
Total	100%

The table shows the range for each letter grade and uses a plus/minus system.

Letter Grade	Points
A	90 – 100 points

A-	85 – 89 points
B+	80 – 84 points
B	75 – 79 points
B-	70 – 74 points
C+	65 – 69 points
C	60 – 64 points
C-	55 – 59 points
D+	50 – 54 points
D	45 – 49 points
D-	40 – 44 points
F	39 and below

Consult the latest Graduate catalogLinks to an external site. for regulations and procedures regarding grading such as Incomplete grades, grade changes, and grade forgiveness.

Course Schedule

The detailed schedule of lectures and exams can be found here.

DAY	DATE			
Mo	8/24/2020	Lecture 1	Introduction	Introduction, history, the laser idea
We	8/26/2020	Lecture 2	Int'n radiation/atoms & ions	Properties of laser light & laser applications
Mo	8/31/2020	Lecture 3	Int'n radiation/atoms & ions	Blackbody radiation, Planck's theorem
We	9/2/2020	Lecture 3	Int'n radiation/atoms & ions	Absorption & emission, relation between Einstein coefficients
	9/7/2020		Labor Day	
We	9/9/2020	Lecture 4	Int'n radiation/atoms & ions	Lineshapes, Lorentz model
Mo	9/14/2020	Lecture 5	The laser	Homogeneous and inhomogeneous broadening mechanisms
We	9/16/2020	Lecture 6	The laser	Saturation of inhom. broadened lines, spectral hole burning
Mo	9/21/2020	Lecture 7	The laser	ASE Energy levels: atoms, molecules, solid-state

We	9/23/2020	Lecture 8	The laser	2, 3, and 4-level lasers
Mo	9/28/2020	Lecture 9	The laser	Continuous wave operation, optimum output coupling
We	9/30/2020	Lecture 10	Recap	Space independent model, Recap
Mo	10/5/2020		Midterm 1	Light interaction with matter: The Laser
We	10/7/2020	Lecture 11	Modes in lasers	Paraxial beams, modes, ABCD matrices, resonator stability
Mo	10/12/2020	Lecture 12	Modes in lasers	Gaussian beams, higher order modes
We	10/14/2020	Lecture 13	Modes in lasers	Passive resonators, eigenmodes, stability
Mo	10/19/2020	Lecture 14	Modes in lasers	multiple modes, unstable resonators, Fabry-Perot interferometer
We	10/21/2020	Lecture 15	Modes in lasers	Longitudinal modes, cavity Q
Mo	10/26/2020	Lecture 16	Pumping	Electrical and optical pumping
We	10/28/2020	Lecture 17	Pulsed lasers	Transient behavior, relaxation oscillation
Mo	11/2/2020	Lecture 18	Pulsed lasers	Q-switching
We	11/4/2020	Lecture 19	Pulsed laser	Mode-locking
Mo	11/9/2020	Lecture 20	Recap	Measurement of laser dynamics, recap
Tue	11/11/2020		Veterans Day	
Mo	11/16/2020		Midterm 2	Modes and laser dynamics
We	11/18/2020	Lecture 21	Semiconductor lasers	Electronic structure of semiconductors, optical spectra
Mo	11/23/2020	Lecture 22	Semiconductor lasers	Optical spectra of semiconductors, quantum size effects
	11/25/2020		Thanksgiving Wednesday	
Mo	11/30/2020	Lecture 23	Semiconductor lasers	Semiconductor diodes, quantum well lasers and VCSELs
We	12/2/2020	Lecture 24	Solid-state lasers	Selected lasers: vibronic, excimer, fiber lasers
		Final Exam	12/7/2020 - 12/12/2020 TBD	

University Services and Resources

Academic Services and Resources

A list of available academic support and learning services is available at UCF Student ServicesLinks to an external site.. Click on "Academic Support and Learning Services" on the right-hand side to filter.

Non-Academic Services and Resources

A list of non-academic support and services is also available at UCF Student ServicesLinks to an external site.. Click on "Support" on the right-hand side to filter. If you are a UCF Online student, please consult the UCF Online Student GuidelinesLinks to an external site. for more information about your access to non-academic services.

Policy Statements

Academic Integrity

Students should familiarize themselves with UCF's Rules of ConductLinks to an external site.. According to Section 1, "Academic Misconduct," students are prohibited from engaging in:

- *Unauthorized assistance*: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
- *Communication to another through written, visual, electronic, or oral means*: The presentation of material which has not been studied or learned, but rather was obtained through someone else's efforts and used as part of an examination, course assignment, or project.
- *Commercial Use of Academic Material*: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor's PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
- *Falsifying or misrepresenting* the student's own academic work.
- *Plagiarism*: Using or appropriating another's work without any indication of the source, thereby attempting to convey the impression that such work is the student's own.
- *Multiple Submissions*: Submitting the same academic work for credit more than once without the express written permission of the instructor.
- *Helping another violate* academic behavior standards.

For more information about Academic Integrity, students may consult The Center for Academic Integrity (Links to an external site.).
For more information about plagiarism and misuse of sources, see "Defining and Avoiding Plagiarism: The WPA Statement on Best Practices (Links to an external site.)".

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, The Golden Rule. Links to an external site.UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and when necessary respond to academic misconduct. Penalties can include a failing grade in an assignment or in the course, suspension or expulsion from the university, and/or a "Z Designation" on a student's official transcript indicating academic dishonesty, where the final grade for this course will be preceded by the letter Z. For more information about the Z Designation, see http://goldenrule.sdes.ucf.edu/zgradeLinks to an external site..

Course Accessibility Statement

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. This syllabus is available in alternate formats upon request. Students with

disabilities who need specific access in this course, such as accommodations, should contact the professor as soon as possible to discuss various access options. Students should also connect with Student Accessibility ServicesLinks to an external site. (Ferrell Commons, 7F, Room 185, sas@ucf.edu, phone (407) 823-2371). Through Student Accessibility Services, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential access and accommodations that might be reasonable.

Campus Safety Statement

Fully online course sections (W, V)

Though most emergency situations are primarily relevant to courses that meet in person, such incidents can also impact online students, either when they are on or near campus to participate in other courses or activities or when their course work is affected by off-campus emergencies. The following policies apply to courses in online modalities.

- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.eduLinks to an external site.> and logging in. Click on "Student Self Service" located on the left side of the screen in the toolbar, scroll down to the blue "Personal Information" heading on the Student Center screen, click on "UCF Alert", fill out the information, including e-mail address, cell phone number, and cell phone provider, click "Apply" to save the changes, and then click "OK."
- Students with special needs related to emergency situations should speak with their instructors outside of class.

Sections with face-to-face components (M, RA, RV)

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
- Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide's physical location and review the online version at <http://emergency.ucf.edu/emergency_guide.htmlLinks to an external site.>.
- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.
- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <http://www.ehs.ucf.edu/AEDlocations-UCFLinks to an external site.> (click on link from menu on left).
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.eduLinks to an external site.> and logging in. Click on "Student Self Service" located on the left side of the screen in the toolbar, scroll down to the blue "Personal Information" heading on the Student Center screen, click on "UCF Alert", fill out the information, including e-mail address, cell phone number, and cell phone provider, click "Apply" to save the changes, and then click "OK."

- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this videoYou CAN Survive an Active Shooter (Links to an external site.)

Statement Regarding COVID-19

University-Wide Face Covering Policy for Common Spaces and Face-to-Face Classes. To protect members of our community, everyone is required to wear a facial covering inside all common spaces including classrooms (https://policies.ucf.edu/documents/PolicyEmergencyCOVIDReturnPolicy.pdfLinks to an external site..)Students who choose not to wear facial coverings will be asked to leave the classroom by the instructor. If they refuse to leave the classroom or put on a facial covering, they may be considered disruptive (please see the Golden RuleLinks to an external site. for student behavior expectations). Faculty have the right to cancel class if the safety and well-being of class members are in jeopardy. Students will be responsible for the material that would have been covered in class as provided by the instructor.

Notifications in Case of Changes to Course Modality

Depending on the course of the pandemic during the semester, the university may make changes to the way classes are offered. If that happens, please look for announcements or messages in Webcourses@UCF or Knights email about changes specific to this course.

COVID-19 and Illness Notification

Students who believe they may have a COVID-19 diagnosis should contact UCF Student Health Services (407-823-2509) so proper contact tracing procedures can take place.

Students should not come to campus if they are ill, are experiencing any symptoms of COVID-19, have tested positive for COVID, or if anyone living in their residence has tested positive or is sick with COVID-19 symptoms. CDC guidance for COVID-19 symptoms is located here: (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html (Links to an external site.))

Students should contact their instructor(s) as soon as possible if they miss class for any illness reason to discuss reasonable adjustments that might need to be made. When possible, students should contact their instructor(s) before missing class.

In Case of Faculty Illness

If the instructor falls ill during the semester, there may be changes to this course, including having a backup instructor take over the course. Please look for announcements or mail in Webcourses@UCF or Knights email for any alterations to this course.

Course Accessibility and Disability COVID-19 Supplemental Statement

Accommodations may need to be added or adjusted should this course shift from an on-campus to a remote format. Students with disabilities should speak with their instructor and should contact sas@ucf.edu to discuss specific accommodations for this or other courses.

Deployed Active Duty Military Students

Students who are deployed active duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make related arrangements.

Copyright

This course may contain copyright protected materials such as audio or video clips, images, text materials, etc. These items are being used with regard to the Fair Use doctrine in order to enhance the learning environment. Please do not copy, duplicate, download or distribute these items. The use of these materials is strictly reserved for this online classroom environment and your use only. All copyright materials are credited to the copyright holder.

Third-Party Software and FERPA

During this course you might have the opportunity to use public online services and/or software applications sometimes called third-party software such as a blog or wiki. While some of these could be required assignments, you need not make any personally identifying information on a public site. Do not post or provide any private information about yourself or your classmates. Where appropriate you may use a pseudonym or nickname. Some written assignments posted publicly may require personal reflection/comments, but the assignments will not require you to disclose any personally identity-sensitive information. If you have any concerns about this, please contact your instructor.

Course Summary:

Date	Details	
Mon Aug 24, 2020	Discussion Topic 1st Group Discussion	to do: 11:45am
	Discussion Topic The laser above the lasing threhold	to do: 11:45am
Fri Aug 28, 2020	Assignment Getting started	due by 11:59pm
	Assignment Assignment Example Copy	
	Assignment Homework example	
	Assignment Homework Example	
	Assignment Homework Example	
	Assignment Homework Example	
	Assignment Quiz Example	