



Course Syllabus

OSE 6527 – Fiber Lasers

Instructor Information

Prof. Axel Schülzgen

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Phone: 407-920-8509

Office: CREOL A115

Office hours: Monday 2:00 – 3:00 pm

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, typically within 24 hours.

Course Information

Term: Spring Semester 2022

Course Number & Section: OSE 6527

Course Name: Fiber Lasers

Class Location: CREOL A214

Class Meeting Days: Monday/Wednesday

Class Meeting Time: 12 noon – 1:15 pm

Class Modality: P

Credit Hours: 3 credit hours

Co-requisite: OSE 6525 – Laser Engineering or equivalent

Enrollment Requirements

Course Prerequisites (if applicable): Graduate standing or consent of instructor

Course Co-requisites (if applicable): OSE 6525 – Laser Engineering or equivalent

Other Enrollment Requirements (if applicable): None

Course Description

Objective:

Graduate students interested in research and development of fiber lasers or closely related technologies acquire and discuss information on fiber lasers from basic concepts to design and performance of state-of-the-art devices.

Description:

Lasers can be found everywhere – at checkout counters in supermarkets to scan barcodes; in copiers, printers, and DVD players; in industrial settings to do materials processing such as marking, drilling, cutting, and welding; in science and engineering for precise measurements of time, distance, temperature, fluid velocity, etc.; in high-speed, high-bandwidth communication systems; and in imaging and remote sensing applications.

Lasers come in many varieties. Fiber lasers technology has been improving dramatically over the two past decades, making fiber lasers serious contenders for many laser applications. Fiber laser technology capitalizes on the rapid development of fiber optic components and advances in high power semiconductor diode lasers to create highly compact and reliable light sources in an all-fiber format. In particular, high-power fiber lasers are attracting much interest among researchers and industry professionals. Several kilowatts of optical power have been generated from a single fiber core using tens of meters of amplifying fiber. Other applications require integration of lasers into compact devices. Sometimes narrow emission spectra or even single frequency operation is needed. For these applications, it is critical to develop special short-length fiber lasers. The flexibility of the fiber optics platform will make fiber lasers a frequent choice to satisfy increasing needs for laser in many fields of application.

This course combines an introduction to fiber lasers with detailed technical discussions based on reviews of recent progress and latest developments in fiber laser research. The laboratory course is designed to reinforce the concepts discussed in class with a hands-on approach and to allow the students to learn laboratory techniques for observing optical phenomena and quantitative experimental characterization in geometrical optics, polarization, interference, and diffraction.

Course Materials and Resources

Textbook:

- No required Textbook.
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- **Supplementary Reading:** Dong & Samson "Fiber Lasers: Basics, Technology, and Applications", CRC 9/2016; Motes & Berdine "High Power Fiber Lasers", DEPS 2009
- Relevant background material for the selected topics will be provided on the course website <https://webcourses.ucf.edu/>

Course Requirements:

- The student is expected to review the provided scientific literature come prepared to participate in class discussions.
- Each student will be asked to select two papers/subjects for presentation.
- By the end of the semester, the students will be required to submit a report on a fiber laser special topic in the style of a journal paper.

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.

Student Learning Outcomes

After successful completion of this course, students will be able to:

- Comment on basic concepts and principles of fiber lasers.
- Discuss fiber laser systems and their mode of operation.
- Discuss material properties and processing techniques for various glasses.
- Read, understand and evaluate scientific reports on fiber lasers.
- Discuss the role of various fiber laser components.
- Discuss special topics in clear and informative presentations.

Course Activities

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

Each student will be asked to select two papers/subjects for presentation.

By the end of the semester, the students will be required to submit a final report on a fiber laser special topic in the style of a journal paper.

How to write the final report:

In any field of science and engineering, once a significant amount of work has been performed, the results of the work should be written up formally. Among other things, this could be in the form of a written report to you supervisors, or to a funding agency, or could be the results of new research that are submitted to a research journal for publication.

It is a requirement of this course that you select one of the selected topics and write a formal report, in the style of a journal publication. You may choose the experimental or theoretical results of one or several publications which either have been provided by the instructor or have been found by yourself. You will use the results of others but provide your own abstract, introduction, discussion and conclusion. It is preferred if you use the style of one of the journals published by the Optical Society of America. Templates can be found at <https://www.osapublishing.org/ao/submit/templates/default.cfm>

The report should contain the following sections: Abstract, Introduction, Experimental methods, Results, Discussion, Conclusions, and References.

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

This course will be taught both face-to-face.

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	20%
Presentations	60%
Final Report	20%

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 catalog for regulations and procedures regarding grading such as Incomplete grades, grade changes, and grade forgiveness.

Course Schedule

List of Lectures (week-by-week calendar; subject to modifications):

DATE			
1/10/2022	Lecture 1	Introduction	Introduction: Fiber Laser Context & Market
1/12/2022	Lecture 2	Introduction	Fiber Laser History
1/17/2022			Martin Luther King Jr. Day
1/19/2022	Lecture 3	Introduction	Impact and History of Glass as Optical Materials
1/24/2022	Lecture 4	Materials	Glass Fundamentals & Making & Processing
1/26/2022	Lecture 5	Materials	Common Glasses & Their Properties
1/31/2022	Lecture 6	Materials	Dopants in Glasses / Transition Metals
2/2/2022	Lecture 7	Materials	Dopants in Glasses / Rare Earth Materials
2/7/2022	Lecture 8	Materials	Rare Earth Doping & Co-Doping
2/9/2022	Lecture 9	Processing	Special Fiber Fabrication, Visit Drawing Facility - Field Trip
2/14/2022	Lecture 10	Fiber Design	Modes / Higher Order Modes
2/16/2022	Lecture 11	Fiber Design	Multimaterial Fiber
2/21/2022	Lecture 12	Fiber Design	Multimode Interference
2/23/2022	Lecture 13	Fiber Design	Birefringence & Polarization Maintaining Fiber
2/28/2022	Lecture 14	Fiber Design	Radially Polarized Modes, Generation & Propagation
3/2/2022	Lecture 15	Fiber Design	Hollow Core and Photonic Bandgap Fibers
3/7/2022			Spring Break
3/9/2022			Spring Break
3/14/2022	Lecture 16	Fiber Design	Micro- and Nanostructured Fiber
3/16/2022	Lecture 17	Fiber Laser Components	Specialty Fiber Optics Components
3/21/2022	Lecture 18	Fiber Laser Components	Fiber Gratings
3/23/2022	Lecture 19	Fiber Laser Components	Distributed Feedback Lasers
3/28/2022	Lecture 20	Fiber Laser Components	Fiber Laser Pumping Schemes
3/30/2022	Lecture 21	Fiber Laser Systems	High Power cw Fiber Laser Systems and High Energy ns Laser Systems
4/4/2022	Lecture 22	Fiber Laser Systems	Mode-Locked fs Fiber Lasers
4/6/2022	Lecture 23	Fiber Laser Systems	Single Frequency Fiber Lasers
4/11/2022	Lecture 24	Fiber Laser Systems	Raman Fiber Lasers
4/13/2022	Lecture 25	Fiber Laser Systems	Multicore Fiber & Fiber Lasers
4/18/2022	Lecture 26	Fiber Laser Systems	Beam Combining
4/20/2022	Lecture 27	Nonlinear Fiber Optics	Stimulated Raman/Brillouin Scattering
4/25/2022	Lecture 28	Nonlinear Fiber Optics	Frequency Conversion Processes
			Final Reports due on or before Sunday May 1

University Services and Resources

Academic Services and Resources:

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

If you are a UCF Online student, please consult the UCF Online Student Guidelines for more information about your access to non-academic services.

Policy Statements

Academic Integrity

Students should familiarize themselves with UCF's Rules of Conduct. 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.

For more information about plagiarism and misuse of sources, see "Defining and Avoiding Plagiarism: The WPA Statement on Best Practices".

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. 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/zgrade>.

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 Services (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.edu>Links 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-UCF>Links 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.edu>Links to an external site.> and logging in. Click on “Student
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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 video [You CAN Survive an Active Shooter](#)

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 expected to wear a facial covering inside all common spaces including classrooms (<https://policies.ucf.edu/documents/PolicyEmergencyCOVIDReturnPolicy.pdf>.)

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>)

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.
