UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

Course Syllabus

OSE 6527 – Fiber Lasers

Instructor Information

Prof. Axel Schülzgen

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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 2025
Course Number & Section:	OSE 6527
Curse Name:	Fiber Lasers
Class Location:	CREOL A214
Class Meeting Days:	Monday/Wednesday
Class Meeting Time:	12 noon – 1:15 pm
Class Modality:	P, V
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.he 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**.

- **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 and through video available online.

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):

DAY	DATE			
Mo	1/6/2023	Lecture 1	Introduction	Introduction: Fiber Laser Context & Market
We	1/8/2023	Lecture 2	Introduction	Fiber Laser History
Mo	1/13/2023	Lecture 3	Introduction	Impact and History of Glass as Optical Materials
We	1/15/2023	Lecture 4	Materials	Glass Fundamentals & Making & Processing
Mo	1/20/2023			Martin Luther King Jr. Day
We	1/22/2023	Lecture 5	Materials	Common Glasses & Their Properties
Mo	1/27/2023	Lecture 6	Materials	Dopants in Glasses / Transition Metals
We	1/29/2023	Lecture 7	Materials	Dopants in Glasses / Rare Earth Materials
Mo	2/3/2023	Lecture 8	Applications	Fiber lab tour - Field Trip - Guest Host 1
We	2/5/2023	Lecture 9	Applications	Fiber lab tour - Field Trip - Guest Host 2
Mo	2/10/2023	Lecture 10	Materials	Multimaterial Fiber
We	2/12/2023	Lecture 11	Fiber Design	Modes / Higher Order Modes
Mo	2/17/2023	Lecture 12	Fiber Design	Multimode Interference
We	2/19/2023	Lecture 13	Fiber Design	Birefringence & Polarization Maintaining Fiber
Mo	2/24/2023	Lecture 14	Fiber Design	Radially Polarized Modes, Generation & Propagation
We	2/26/2023	Lecture 15	Fiber Design	Hollow Core and Photonic Bandgap Fibers
Mo	3/3/2023	Lecture 16	Fiber Design	Micro- and Nanostructured FiberSpring Break
We	3/5/2023	Lecture 17	Fiber Laser Components	Specialty Fiber Optics Components
Mo	3/10/2023	Lecture 18	Fiber Laser Components	Fiber Gratings
We	3/12/2023	Lecture 19	Fiber Laser Components	Distributed Feedback Lasers
Mo	3/17/2023			Spring Break
We	3/19/2023			Spring Break
Mo	3/24/2023	Lecture 20	Fiber Laser Components	Fiber Laser Pumping Schemes
We	3/26/2023	Lecture 21	Fiber Laser Systems	High Power cw Fiber Laser Systems and High Energy ns Laser Systems
Mo	3/31/2023	Lecture 22	Fiber Laser Systems	Mode-Locked fs Fiber Lasers
We	4/2/2023	Lecture 23	Fiber Laser Systems	Single Frequency Fiber Lasers
Mo	4/7/2023	Lecture 24	Fiber Laser Systems	Raman Fiber Lasers
We	4/9/2023	Lecture 25	Fiber Laser Systems	Multicore Fiber & Fiber Lasers
Mo	4/14/2023	Lecture 26	Fiber Laser Systems	Beam Combining
We	4/16/2023	Lecture 27	Nonlinear Fiber Optics	Stimulated Raman/Brillouin Scattering
Mo	4/21/2023	Lecture 28	Nonlinear Fiber Optics	Frequency Conversion Processes

Final Reports due on or before Monday, April 28

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 at https://scai.sdes.ucf.edu/student-rules-of-conduct/. According to Section 1, "Academic Misconduct," students are prohibited from engaging intudents should familiarize themselves with UCF's Rules of Conduct. According to Section 1, "Academic Misconduct," students are prohibited from engaging in:

1. 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.

2. 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.

3. 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.

4. Falsifying or misrepresenting the student's own academic work.

5. 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.

6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.

7. Helping another violate academic behavior standards.

8. Soliciting assistance with academic coursework and/or degree requirements.

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 familiarize themselves with the procedures for academic misconduct in UCF's student handbook, The Golden Rule https://goldenrule.sdes.ucf.edu/. UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the

Office of Student Conduct, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

Unauthorized Use of Websites and Internet Resources

There are many websites claiming to offer study aids to students, but in using such websites, students could find themselves in violation of academic conduct guidelines. These websites include (but are not limited to) Quizlet, Course Hero, Chegg Study, and Clutch Prep. UCF does not endorse the use of these products in an unethical manner, which could lead to a violation of our University's Rules of Conduct.

They encourage students to upload course materials, such as test questions, individual assignments, and examples of graded material. Such materials are the intellectual property of instructors, the university, or publishers and may not be distributed without prior authorization. Students who engage in such activity could be found in violation of academic conduct standards and could face course and/or University penalties. Please let me know if you are uncertain about the use of a website so I can determine its legitimacy.

Unauthorized Distribution of Class Notes

Third parties may attempt to connect with you to sell your notes and other course information from this class. Distributing course materials to a third party without the my authorization is a violation of our University's Rules of Conduct. Please be aware that such class materials that may have already been given to such third parties may contain errors, which could affect your performance or grade.

Recommendations for success in this course include coming to class on a routine basis, visiting me during my office hours, connecting with the Teaching Assistant (TA), and making use of the Student Academic Resource Center (SARC), the University Writing Center (UWC), the Math Lab, etc. If a third party should contact you regarding such an offer, I would appreciate your bringing this to my attention. We all play a part in creating a course climate of integrity.

In-Class Recording

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach enrolled students about a particular subject.

Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, private conversations between students in the class or between a student and the faculty member, and invited guest speakers is prohibited.

Recordings may not be used as a substitute for class participation and class attendance and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule.

Course Accessibility Statement

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) http://sas.sdes.ucf.edu/ (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371).

For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

Deployed Active Duty Military Students

If you are a deployed active duty military student and feel that you may need a special accommodation due to that unique status, please contact your instructor to discuss your circumstances.

Campus Safety Statement

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 https://centralflorida-prod.modolabs.net/student/safety/index.
- 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 https://ehs.ucf.edu/automated-external-defibrillator-aed-locations.
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to https://my.ucf.edu 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 video https://youtu.be/NIKYajEx4pk.

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.