UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

Course Syllabus

OSE 6938U – ST: Fiber Lasers

Instructor: Prof. Axel Schülzgen

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Office: CREOL A115

Office hours: Wednesday 2:00 – 3:00 pm

Class location: CREOL A214

Class meeting days: Tuesday/Thursday

Class meeting time: 1:30 – 2:45 pm

Class website: UCF Webcourses

Credit Hours: 3 credit hours

Co-requisite: OSE 6525 – Laser Engineering or equivalent

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.

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 Materials and Textbook:

- **No required Textbook**.
- **Supplementary Reading:** Motes & Berdine "High Power Fiber Lasers"
- 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.

Grading policy:

The course will be graded in A-F. The final grade will be based upon:

Presentations	65%
Final report	25%
Participation in class	10%

University Rules on Professionalism and Ethics

Per university policy and plain classroom etiquette, mobile phones, etc. must be silenced during all classroom lectures, unless you are specifically asked to make use of such devices for certain activities.

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.

Cheating and plagiarism are serious breaches of the UCF Code of Honor as described in the UCF Golden Rule and the UCF Creed, and will not be tolerated in this course. All cases will be reported to the Office of Student Conduct (OSC).

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.**

If there is any question concerning acceptable practices, don't hesitate to ask the instructor.

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.

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 28; Attendance certification. Failure to do so will result in a delay in the disbursement of your financial aid.

Class Website:

Materials used for classes will be available on UCF Webcourses for download.

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

8/25/2015	Lecture 1	Introduction	Introduction: Fiber Laser Context & Market
8/27/2015	Lecture 2	Introduction	Fiber Optics History
9/1/2015	Lecture 3	Introduction	Fiber Laser History / Impact and History of Glass as Optical Materials
9/3/2015			Football
9/8/2015	Lecture 4	Materials	Glass Fundamentals & Making & Processing
9/10/2015	Lecture 5	Materials	Common Glasses & Their Properties
9/15/2015	Lecture 6	Materials	Dopants in Glasses / Transition Metals
9/17/2015	Lecture 7	Materials	Dopants in Glasses / Rare Earth Materials
9/22/2015	Lecture 8	Materials	Rare Earth Doping & Co-Doping
9/24/2015	Lecture 9	Processing	Special Fiber Fabrication
9/29/2015	Lecture 10	Fiber Design	Modes / Higher Order Modes
10/1/2015	Lecture 11	Fiber Design	Multimaterial Fiber
10/6/2015	Lecture 12	Fiber Design	Multimode Interference
10/8/2015	Lecture 13	Fiber Design	Birefringence & Polarization Maintaining Fiber
10/13/2015	Lecture 14	Fiber Design	Radially Polarized Modes, Generation & Propagation
10/15/2015	Lecture 15	Fiber Design	Micro- and Nanostructured Fiber
10/20/2015	Lecture 16	Fiber Design	Photonic Bandgap Fibers
10/22/2015	Lecture 17	Fiber Design	Multicore Fiber & Fiber Lasers
10/27/2015	Lecture 18	Fiber Laser Components	Fiber Laser Pumping Schemes
10/29/2015	Lecture 19	Fiber Laser Components	Specialty Fiber Optics Components
11/3/2015	Lecture 20	Fiber Laser Components	Fiber Gratings
11/5/2015	Lecture 21	Fiber Laser Components	Distributed Feedback Lasers
11/10/2015	Lecture 22	Fiber Laser Systems	High Power cw Fiber Laser Systems
11/12/2015	Lecture 23	Fiber Laser Systems	High Energy ns Fiber Laser Systems
11/17/2015	Lecture 24	Fiber Laser Systems	Mode-Locked fs Fiber Lasers
11/19/2015	Lecture 25	Fiber Laser Systems	Single Frequency Fiber Lasers
11/24/2015	Lecture 26	Fiber Laser Systems	Beam Combining
11/26/2015			Thanksgiving
12/1/2015	Lecture 27	Nonlinear Fiber Optics	Stimulated Raman/Brillouin Scattering
12/3/2015	Lecture 28	Nonlinear Fiber Optics	Frequency Conversion/Supercontinuum Generation
	Final Exam		Final Reports due Friday Dec. 11
			Grades due Friday Dec. 18

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.