UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

Course Syllabus

COURSE NUMBER AND TITLE, CREDIT HOURS

Instructor:	Peter J. Delfyett	**Term:**	Spring 2019
Email:	delfyett@creol.ucf.edu	**Class Meeting Days:**	Monday, Wednesday
Phone:	407 823 6812	**Class Meeting Time:**	10:30-11:45pm
Office:	CREOL, Rm. 272	**Class Location**	CREOL A214
Office Hours:	Mon, Wed., 2:00-3:00pm	**Website:**	

Additional Notes: 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.

Course Catalog Description: Laser Engineering
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.

Prerequisites: OSE 3052 or PHY 4424 or EEL 4440.

Detailed Course Description and Learning Outcomes:
Detailed Description - Topics to be Covered:

I. Laser Fundamentals: Overview, Energy states in atoms, Basic stimulated emission, Power and energy, Monochromaticity, coherency and linewidth, spatial coherence, longitudinal and transverse modes, gain profile.

II. Energy States and Gain: Laser states, multiple-state laser systems, linewidth and the uncertainty principle, broadening of fundamental linewidths; basics of gain, blackbody radiation, gain.

III. The Fabry Perot Etalon: Longitudinal modes in the laser resonator cavity, quantitative analysis of a Fabry Perot etalon, illustrative Fabry Perot etalon calculations.

Mid-Term Exam

IV. Transverse Mode Properties: TEM transverse modes, Gaussian beam propagation, ray matricies, Gaussian beams in resonant cavities, ABCD Law

V. Gain Saturation: Saturation of the exponential gain process, homogeneous and inhomogeneous gain saturation, Rate equations, Laser output power characteristics

VI. Transient Processes: Relaxation oscillations, Q-switching; Mode-locking

VII. Introduction to Nonlinear Frequency Conversion: X^2 processes, e.g., second harmonic generation; X^3 processes

Final Exam (Cumulative)

Learning Outcomes:
A student's grade will also be assessed on their ability to:
1) Analyze the conditions for population inversion and optical amplification in gain media and determine the threshold gain for laser action.
2) Determine the layout of optical components that produce a laser spot of given dimensions at a given distance.

3) Model a stable cavity with prescribed beam characteristics.

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.	High
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.	Medium
(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.	High
(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.	Low
(g) An ability to communicate effectively.	Medium
(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.	High

Textbook: Laser Engineering, Kelin J. Kuhn, Prentice Hall, (1998)
ISBN 0-020366921-7

Course Grading and Requirements for Success:

Homework: Required
Exams: Mid-term and Final; Scheduled
Quizzes: In class, randomly scheduled
Participation: Required
Final Exam: Required
Make up Exam Policy: 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.
Attendance:

Criteria	Grade Weighting
Homework & Quizzes	10%
Participation	required
Midterm Exam	45%
Final Exam	45%
Total	100%

Final Exam Date: See published schedule by UCF

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.

Grading Scale (%)	Rubric Description
100 ≥ 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.
> B ≥	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
> C ≥	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
> 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 situtations.
> F ≥ 0	Demonstrates no understanding of the course content.

Grade 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.

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 in the UCF Student Handbook (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.

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 www.sds.sdes.ucf.edu or at (407)823-2371.

Dates:

First Day of Class	Jan. 7
Last Day to Drop Classes:	Jan. 10, Mar 20
Last Day to Add Classes:	Jan. 11
Final Exam:	April 29; 10:00-12:50pm

COURSE, TERM, INSTRUCTOR **Daily Schedule (subject to change)**			
Week	Date	Concepts Presented:	Textbook chapter
1	Jan 7, Jan 9	Overview, Energy states in atoms, Basic stimulated emission, Power and energy, Monochromaticity	
2	14(NC), 16	Coherency and linewidth, spatial coherence, longitudinal and transverse modes, gain profile.	
3	21, 23	Laser states, multiple-state laser systems, linewidth and the uncertainty principle	
4	28, 30	Broadening of fundamental linewidths; basics of gain, blackbody radiation, gain	
5	Feb 4, Feb 6	Longitudinal modes in the laser resonator cavity, quantitative analysis of a Fabry Perot etalon, illustrative Fabry Perot etalon calculations	
6	11, 13	Review, Midterm	
7	18, 20	TEM transverse modes, Gaussian beam propagation, ray matricies	
8	25, 27	Gaussian beams in resonant cavities, ABCD Law	
9	Mar 4, Mar 6	Saturation of the exponential gain process	
10	11, 13	Spring Break	
11	18, 20	Homogeneous and inhomogeneous gain saturation	
12	25, 27	Rate equations, Laser output power characteristics	
13	Apr 1, Apr 3	Relaxation oscillations	

14	8, 10	Q-switching; Mode-locking	
15	15, 17, 22	Semiconductor Lasers, X^2 processes, e.g., second harmonic generation; X^3 processes – Semester Review	
	Monday, Apr. 29, 2018 1:00 PM – 3:50 PM	Final Exam	