

ELEC 5709: Lasers

Course Description and Requirements

Course Description: This course is intended to serve as an introduction to Lasers. Topics covered in the course will include absorption, emission, broadening mechanisms, dispersion, gain, population inversion, three and four-level lasing schemes, Q-switching, mode-locking, gaussian beam optics and laser light propagation.

Lectures: 3 hours per week. M/W 2:35-3:55 pm, PA 115.

Instructor

Professor: Christopher W. Smelser

Email: Christopher.Smelser@carleton.ca

Office: ME 5144

Course Webpage: on Brightspace

Textbook:

The recommended texts for this course is:

Laser Physics

By Peter W. Milonni and Joseph H. Eberley

ISBN: 978-0-470-38771-9

\$181.38 on Amazon

Understanding Lasers

By Jeff Hecht

ISBN: 978-1-119-31064-8

\$60 on Amazon

Lecture Outline

Week	Due Date	Topics / Assignments	Reading / Assignment
1	<u>Sept. 7</u>	<u>Introduction to Laser Operation; Overview of Lasers</u>	<u>Chapter 1 (Milonni/Eberley)</u> <u>Chapter 1 (Hecht)</u>
2	<u>Sept. 14, 16</u>	<u>Atoms, Molecules and Solids: Energy Levels, Insulators, Semiconductors and LED's</u> <u>Physical Basics</u>	<u>Chapter 2 (Milonni/Eberley)</u> <u>Chapter 2 (Hecht)</u>

3	<u>Sept. 21, 23</u>	<u>Absorption and Emission: Spontaneous Emission, Absorption, Broadening</u>	<u>Chapter 3 (Milonni/Eberley)</u> <u>Chapter 2 (Hecht)</u>
4 -	<u>Sept. 28, 30</u>	<u>Absorption and Emission cont'd</u> -	<u>Chapter 3 (Milonni/Eberley)</u> <u>Chapter 2 (Hecht)</u> -
5	<u>Oct. 5, 7</u>	<u>Laser Oscillation: Gain and Threshold: Feedback, Rate equations, Three and Four-level laser schemes, Small-signal gain and saturation, Spatial Hole burning and Spectral Hole Burning</u>	<u>Chapter 4</u>
6	<u>Oct. 14</u>	<u>Laser Resonators; Longitudinal Modes; Transverse Modes; Single mode operation</u> -	<u>Chapter 7 (Milonni/Eberley)</u> <u>Chapter 3 (Hecht)</u>
7	<u>Oct. 19</u>	<u>Multi-mode and Pulsed Lasing: Q-switching, Mode Locking, Amplified Spontaneous emission</u>	<u>Chapter 6 (Milonni/Eberley)</u>
7	<u>Oct. 21</u>	<u>Test 1</u>	<u>Up until week 6</u>
8	<u>Oct. 26-30</u>	<u>Reading Week</u>	-
9	<u>Nov. 2, 4</u>	<u>Multi-mode and Pulsed Lasing: Q-switching, Mode Locking, Amplified Spontaneous emission (cont'd)</u> - <u>Laser Properties: Linewidth, Coherence, Polarization, Propagation, Dispersion.</u>	<u>Chapter 8 (Milonni/Eberley)</u> <u>Chapter 4-6 (Hecht)</u>
10	<u>Nov. 9, Nov. 11</u>	<u>Laser Types: Gas Lasers, Solid State Lasers, Fiber Lasers, Semiconductor Lasers</u> -	<u>Chapter 7-10 (Hecht)</u>
11	<u>Nov. 16, Nov. 18</u>	<u>Applications of Lasers.</u>	<u>Chapter 12-13 (Hecht)</u>
12	<u>Nov. 23</u>	<u>Applications of Lasers (cont'd)</u>	<u>Chapter 12-13 (Hecht)</u>
12	<u>Nov. 25</u>	<u>Test 2</u>	<u>Weeks 7-11</u>
13	<u>Nov. 30, Dec. 2</u>	<u>Presentations</u>	-
13	<u>Dec. 7, Dec. 9</u>	<u>Presentations</u>	-
13	<u>Dec. 11</u>	<u>Presentations/Lab Tour</u>	-

Self-Declaration form and Deferred Term work

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for submitting a self-declaration form no later than three (3) days after the date/deadline of term work including test/midterm, labs, assignments. Any alternate arrangements made with the instructor for submission of term work should be made as soon as possible but within 3 days of the missed due date. If this is not possible after discussion with the instructor, alternate arrangements must be made before the last day of classes in the term as published in the academic schedule.

Grading Scheme

	%
Test 1	30
Test 2	30
Final Report	20
Final Presentation	20
Total	100

Final Presentation and Report:

The final presentation and report will be based on an application of Lasers. A list of acceptable topics will be provided during the term. The presentation will be 30 minutes, where you will present an overview of your chosen topic. The final report will be a 10-page summary of your presentation.

Course Policies:

Late Final Report: Final Reports are expected to be handed in on Brightspace by the end of the exam period. Failure to hand the report in on Brightspace prior to this will result in a 20 % penalty per day up to a maximum of 5 days.

Plagiarism: The reports in this course are expected to be done individually.

AI: Use of generative AI tools (such as ChatGPT) is allowed for you develop your understanding of your presentation topic and develop your report. Be aware that I will be asking questions related to your presentation, so ensure that you understand your topic.

Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity>.

Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- Any submission prepared in whole or in part, by someone else;
- Using another’s data or research findings without appropriate acknowledgment;
- Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own;
- Failing to acknowledge sources of information through the use of proper citations when using another’s work and/or failing to use quotation marks; and

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form ([click here](#)).

Religious obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details [click here](#).

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send us your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, contact us, if needed, to ensure that accommodation arrangements are made.

You should request your academic accommodations in the [Ventus Student Portal](#), for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm.

Please consult the [PMC website](#) for the deadline to request accommodations for formally-scheduled exams (if applicable).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/equity/sexual-assault-support-services>

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist: <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>