Carleton University

Department of Electronics

Fall 2025

ELEC5301F: Silicon Photonics

Introduction

In this course, you will learn the fundamentals of silicon photonics.

Course Description and Requirements

Course Description: Review of wave optics; electromagnetic optics; polarization optics; guided wave optics; interference; interferometry; resonator optics; semiconductors; lasers and detectors. Photonic devices using silicon: passive devices (waveguides), active devices (modulators, lasers, photodetectors), opto-electronic integration, applications in bio-medical sensing, telecommunication, and renewable energy.
Includes: Learning of the industry-standard design tool Lumerical®
Prerequisite(s): ELEC3909 or equivalent course(s) on the introduction of electromagnetics
Lectures: Wednesdays at 11:30 to 14:30 in ME3190

Instructor

Professor: Winnie Ye (https://carleton.ca/winnieye/)
Email: winnie.ye@carleton.ca – best way is via email option on Brightspace
Course Webpage: on Brightspace

Textbook: Not required, but recommended

1) Silicon Photonics: The State of the Art, Graham T. Reed; Wiley 2008. ISBN: 9780470025796 ($157)
2) Silicon Photonics: An Introduction, Graham T. Reed and Andrew P. Knights; Wiley 2004. ISBN: 0470870346 ($144)
3) Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich; Wiley, 2007. ISBN: 978-8126537747 ($92)

Lecture Outline

The following topics will be covered during the course lectures with an approximate schedule:
Week 1: Chapter 1: Introduction
Week 2: Chapter 2: Waveguides Theory and Properties
Week 3: Chapter 3: Coupling Theory
Week 4: Chapter 4: Passive Devices: Directional Couplers, MMIs, Y-junctions, MZI, AWG
Week 5-6: Chapter 5: Resonators: Ring Resonators, Photonic Crystals
*Note: Oct 1st lecture will be a pre-recorded video.
Week 7: Chapter 6: Active Devices: Modulators
Fall break: Oct 20th to Oct 24th, 2025
Week 8: Chapter 7: Active Devices - Optical Sources (light-emitting diodes, optical amplifiers, lasers)
Week 9: Chapter 8: Active Devices - Light Detectors (photodetectors, photodiodes, avalanche photodiodes)

Week 10: Chapter 9: Optoelectronic Integration
Week 11: Chapter 10: Applications
Week 12: Project Presentations

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.

The student is required to submit the self-declaration form. Include the following statement if you require the student to submit a completed self-declaration form:

> **Consult with the instructor no later then 3 days after any missed course work or midterm examination.**
>
> or
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> **Contact the instructor with the completed self-declaration form no later than 3 days after the date/deadline of term work including test/midterm, labs, assignments.**

Evaluation and Grading Scheme

The cumulative course grade will be determined as follows:

Assignments (40%) and Term Project (60%)

Learning Outcomes

Upon successful completion of this course, students will be able to:
1) Understand the fundamentals of silicon photonics
2) Design basic photonics devices using the industry-standard design tool Lumerical®
3) Perform research literature review
4) Write a short review paper

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 quotations marks; and
- Unless explicitly permitted by the instructor in a specific course, the use of generative AI and similar tools to produce assessed content (such as text, code, equations, images, summaries, videos, etc.).

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