

## Photonic Integrated Circuits: From Theory to Practice and Applications (E030490)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 8.0**

**Study time 240 h**

**Course offerings in academic year 2025-2026**

A (Year)

English

Gent

**Lecturers in academic year 2025-2026**

Bogaerts, Wim

TW05

lecturer-in-charge

Verstuyft, Mattias

TW05

co-lecturer

**Offered in the following programmes in 2025-2026**

[Micro-credential Photonic Integrated Circuits: From Theory to Practice and Applications](#)

**crdts**

8

**offering**

A

**Teaching languages**

English

**Keywords**

Photonic chip, PIC design, PIC simulation, PIC fabrication and PIC measurements

**Position of the course**

Driven by the current needs of data centers and artificial intelligence, the field of integrated photonics is growing rapidly, resulting in a shortage of skilled researchers and engineers.

This microcredential is designed to equip lifelong learners with the necessary skills and knowledge to make a difference in this cutting-edge field, from core technologies to diverse applications in telecommunications, data communications, sensors and biomedical technology, and quantum information processing. Both simulation and modeling of chip design are covered, as well as insight into the necessary materials and fabrication techniques to ultimately characterize and measure a working photonic chip.

**Contents**

- Introduction : PICs and Silicon Photonics
- Quickstart: Photonic Circuit Design + info of the design project
- Waveguides and PIC platforms
- PIC components: passive and active building blocks
- PIC fabrication processes and relation tot the CMOS process flow
- Heterogeneous integration for silicon photonics
- Circuit abstraction? Why?
- Ways to describe photonic circuits? Signals, ports, models
- Time domain/frequency domain circuit simulation
- Circuit Design Flow and Chip Layout
- Wavelength Filter Circuits
- Component Simulation and Component Simulation Quiz
- Programmable Photonics
- Co-integration techniques, Co-design and co-simulation considerations
- Control loops
- Design for Manufacturability
- Hands-on characterization labs
- Packaging for PICs
- Applications
- Company visits

**Initial competences**

### Final competences

- 1 Understanding of the working principles of PIC components (active and passive), and how they can be combined into circuits.
- 2 Understanding the essential modelling and simulation techniques for PICs components and circuits, being able to select the most suitable method for a problem, and applying the techniques (with commercial tools).
- 3 Understanding photonic circuit formalisms, how they differ from electronic circuits. Being able to construct photonic circuits, simulate them, and generate a layout that can be fabricated.
- 4 Understanding the fundamental concepts of wavelength filters, and the different implementations with their strengths and weaknesses.
- 5 An insight into the different technology platforms for PICs, their fabrication processes, and how PICs can serve a diversity of applications.
- 6 Having hands-on experience in designing a photonic integrated circuit with tunable elements, the associated fabrication and packaging flow, and being able to characterize the chip using lab equipment and driver electronics.
- 7 An insight in the PIC Ecosystem of Ghent, Leuven and Eindhoven (and beyond).
- 8 Connecting with stakeholders.

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Seminar, Excursion, Lecture, Independent work

### Extra information on the teaching methods

Lectures (including guest lectures), hands-on Jupyter notebooks, supervised labs (cleanroom and measurements).

### Study material

Type: Slides

Name: slides used during the course, lecture recording and Jupyter notebooks

Indicative price: Free or paid by faculty

Optional: no

Additional information: Available electronically (free)

### References

### Course content-related study coaching

### Assessment moments

end-of-term and continuous assessment

### Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment

### Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment

### Examination methods in case of permanent assessment

Assignment

### Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

### Extra information on the examination methods

- End-of-term evaluation: oral closed book assessment, written assessment closed book
- Continuous evaluation: assignment: design project and lab exercises

### Calculation of the examination mark

30% written exam, 20% oral exam; 30% design project, 20% lab exercises.

