GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Materials for Photonic Integrated Circuits (E030440)

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

Credits 4.0 **Study time 120 h**

Course offerings in academic year 2025-2026

A (semester 1)	English	Gent

Lecturers in academic year 2025-2026

Beeckman, Jeroen	TWO6	lecturer-in-charge
Stebrytė, Miglė	TWO6	co-lecturer

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Master of Science in Silicon Photonics	4	A

Teaching languages

English

Keywords

Light matter interaction, electro-optic material, light generation

Position of the course

Expose the students to basic concepts of light matter interaction relevant for PICs

Contents

Recap of basic solid-state physics and semiconductor physics
Crystal structure, band diagrams, Fermi level, electron/holes, doping, electric fields & current in semiconductors, recombination/generation, 2D semiconductors, organic semiconductors, from bulk to nano: quantum wells, quantum dots
Light propagation in isotropic and anisotropic dielectric materials
Interaction of light with semiconductors
Absorption (interband/intraband), the role of excitons, phonons. Application in photodiodes.
Modulation
Modification of optical properties in dielectric materials: microscopic theory, electro- photo- elasto- acousto- magneto- optic effects
Modulation in semiconductors: Plasma dispersion effect (injection, accumulation, depletion), Electro-absorption (Franz-Keldysh effect, Quantum Confined Stark effect), modulation in III-V semiconductors
Light generation in semiconductors
Charge injection, spontaneous emission, diodes, Quantum dots

Initial competences

Basic solid-state physics at the undergraduate level

Final competences

1 Understand the basic theoretical concepts of solid state and semiconductor physics
2 Calculate the polarization of light propagating in anisotropic materials
3 Understand the physics of absorption of light in semiconductors and its relation to photodiodes
4 Understand and explain mechanisms for modifying the optical properties of materials: electric, magnetic, elastic and acoustic methods
5 Calculate the effects of optical modulation mechanisms in dielectric and semiconductor materials on optical wave propagation
6 Understand and explain the mechanisms of light generation in semiconductors

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, Lecture, Independent work

Study material

Type: Slides

Name: Slides and course notes used during the course
Indicative price: € 11
Optional: no
Additional information: Available electronically (free) or through the student organization (8 /11,5 Euro member/non-member)

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 open-book

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

Oral assessment, Written assessment open-book

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

- During examination period: written open-book assessment and oral closed-book assessment.
- During semester: graded assignment.

Calculation of the examination mark

40% written, 30% oral exam, 30% assignment.