GHENT UNIVERSITY

# Course Specifications

From the academic year 2021-2022 up to and including the academic year

## Microphotonics (E030761)

**Due to Covid 19, the education and assessment methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.**

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

**Credits 6.0** **Study time 180 h** **Contact hrs** 60.0h

**Course offerings and teaching methods in academic year 2021-2022**

| | | | | |
|---|---|---|---|---|
| A (semester 1) | English | Gent | project | 15.0h |
| | | | seminar: coached exercises | 15.0h |
| | | | lecture | 30.0h |
| B (semester 1) | Dutch | Gent | seminar: coached exercises | 15.0h |
| | | | project | 15.0h |
| | | | guided self-study | 30.0h |
| O (semester 1) | English | Gent | | |

**Lecturers in academic year 2021-2022**

| | | |
|---|---|---|
| Van Thourhout, Dries | TWO5 | lecturer-in-charge |
| Baets, Roel | TWO5 | co-lecturer |
| Ottevaere, Heidi | VUB | co-lecturer |

| **Offered in the following programmes in 2021-2022** | **crdts** | **offering** |
|---|---|---|
| Bridging Programme Master of Science in Photonics Engineering | 6 | A |
| Master of Science in Electrical Engineering (main subject Communication and Information Technology ) | 6 | A |
| Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation) | 6 | A |
| Master of Science in Electromechanical Engineering(main subject Electrical Power Engineering) | 6 | A |
| Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems) | 6 | A |
| Master of Science in Electromechanical Engineering(main subject Maritime Engineering) | 6 | A |
| Master of Science in Electromechanical Engineering(main subject Mechanical Construction) | 6 | A |
| Master of Science in Electromechanical Engineering(main subject Mechanical Energy Engineering) | 6 | A |
| European Master of Science in Photonics | 6 | A |
| International Master of Science in Biomedical Engineering | 6 | A, B |
| Master of Science in Biomedical Engineering | 6 | A, B |
| Master of Science in Biomedical Engineering | 6 | A, B |
| Master of Science in Photonics Engineering | 6 | A, O |

**Teaching languages**

English, Dutch

**Keywords**

diffraction, interference, waveguides, periodic structures and gratings, polarisation and anisotropy, microsystems

**Position of the course**

In depth treatment of fundamental concepts behind light propagation in a variety of photonic components and systems. The approach used in this course puts emphasis on the basic underlying theory as well as on analytic and computer aided design methods. Applications are briefly described.

**Contents**

- Introduction
- Matrix descriptions of wave propagation in linear systems: Transfer matrices and S-matrices (bidirectional), Representation of light polarisation (Jones, Stokes, Poincare), Jonesmatrices
- Thin films: Reflection and transmission of layered media: tranfer matrix method, Coatings
- Fourier Optics: Diffraction theory: Fresnel and Fraunhofer, Fourier transform properties of lenses, Resolving power of imaging systems (MTF)
- Dielectric waveguides: Theory of slab and stripe waveguide, Numerical simulation methods for waveguide structures, Waveguide structures: bends, junctions, couplers
- Periodic media: Bragg condition, Surface and volume gratings, Grating spectrometers, Concepts of holography, Concepts of photonic crystals
- Photonic components and microsystems: Light modulators (electro-optical, acousto-optical, thermo-optical, electro-absorption), Polarisation based components (polarisation conversion, polarisers, isolators), Optical switching systems (scaling concepts, planar systems, 3D systems (MEMS))
- Optical measurement systems: Spectrometers (Fabry-Perot, FTIR, grating), Microscopy and profilometry
- Project

**Initial competences**

Introductory course on photonics and on electromagnetism.

**Final competences**

1 Understanding of transfer matrices, S-matrices, Jones matrices, Stokes parameters, Poincare sphere.
2 Analysing thin films conceptually and by means of CAD tools.
3 Understanding of Fourier optics, Fraunhofer and Fresnel diffraction, Fourier transform properties of lenses, MTF.
4 Understanding of waveguides and basic waveguide based components. Analyse waveguide modes by means of CAD tools.
5 Understanding of the diffraction behaviour of surface and volume gratings.
6 Understanding in the basic operation of the most important passive and active photonic components.
7 Understanding of the basic operation of optical measurement systems (spectrometers, microscopes, profilometers).

**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**

Online lecture: plenary exercises, Online lecture, Online seminar: practical pc room classes, Guided self-study, Lecture, Project, Seminar: coached exercises, Seminar: practical pc room classes

**Learning materials and price**

Syllabus (in English).
Available electronically (free) or through the student organisation (8,0/11,5 Euro member/non-member)

**References**

- M. Born and E. Wolf, Principles of Optics, Pergamon Press
- M. Klein, T. Kurtak, Optics, John Wiley
- K. D. Möller, Optics, University Science Books
- J. Goodman, Introduction to Fourier Optics, McGraw Hill 1968
- R.Märtz , Integrated Optics, Design and Modeling, Artech House, Boston, London (ISBN 0-89006-668-X),
- C. Vassallo, Optical Wave Sciences and Technology, Part 1 Optical Waveguide Concepts, Elsevier

**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**

Written examination, Oral examination, Open book examination

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

Written examination, Oral examination, Open book examination

**Examination methods in case of permanent assessment**

Report

**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**

During examination period: written open-book exam and oral closed-book examination. During semester: graded project reports. Frequency: About every two weeks, spread over the semester.

**Calculation of the examination mark**

Special conditions: project based on a number of CAD-sessions: 30%. Exam: 70%.