GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2021-2022

Microphotonics (E030761)

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

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

Course offerings and teaching methods in academic year 2022-2023

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

Lecturers in academic year 2022-2023

Van Thourhout, Dries	TW05	lecturer-in-charge
Baets, Roel	TW05	co-lecturer
Ottevaere, Heidi	VUB	co-lecturer

Offered in the following programmes in 2022-2023	**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
Master of Science in Biomedical Engineering	6	A
Master of Science in Photonics Engineering	6	A, O

Teaching languages

Dutch, English

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

Guided self-study, lecture, project, seminar: coached exercises, seminar: practical PC room classes, online lecture, online lecture: plenary exercises, online 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

Evaluation methods

end-of-term and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination, oral examination

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

Written examination, open book examination, oral examination

Examination methods in case of permanent evaluation

Report

Possibilities of retake in case of permanent evaluation

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%.