GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Optical Sensors (E030920)

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

Credits 4.0 **Study time 120 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	English	Gent	lecture

Lecturers in academic year 2025-2026

Geernaert, Thomas	VUB	lecturer-in-charge
Berghmans, Francis	VUB	co-lecturer

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

Teaching languages

English

Keywords

Sensor, measurement techniques, optical, fiber

Position of the course

This series of lectures introduces how a light signal can be used to measure the most common physical quantities such as distance, displacement, speed, acceleration, temperature, mechanical forces and deformation. The course serves a twofold purpose. First it tries to give an overview of the different physical mechanisms through which the optical sensor changes the characteristics of a light signal by allowing it to interact with a physical measurand. Second, it describes how optical sensors are built, what their main specifications are and which aspects one has to consider for building an effective sensor.

The course is entirely taught in Brussels at VUB - Campus Etterbeek, as part of the interuniversity master's programme Master of Science in Photonics Engineering.

Contents

- Introduction: Definition of sensor, measurable quantities and overview of optical measurement principles; Review of most important characteristics of an optical signal; Review principles of interferometry; Review Bragg condition; Review electrooptic and elastooptic effect
- Optical sensors - free space: Measurement of distance and displacement; Measurement of speed and acceleration; Measurement of temperature
- Optical sensors - optical fibers: Introduction; Interferometric sensors; Bragg gratings as optical fiber sensor; Multiplexing and distributed sensors

Initial competences

Electromagnetism, polarization of light, interference of electromagnetic waves, optical fibers.

Final competences

1 Understand the most important optical measurement techniques.
2 Be able to choose the right technique for a particular measurement problem.
3 Master and apply advanced knowledge in the own field of engineering in case of complex problems.
4 Thoroughly understand and apply several areas of specialisation (to be chosen by the student) in the field of optical sensors.

5 Be acquainted with the recent innovation trends in the domain of optical sensors.
6 Have knowledge of the most important application areas of photonic materials, components and systems.
7 Perform research by means of scientific literature.
8 Analyse own results and results of others in an objective manner.
9 Understand the context of technical or scientific papers in the field of optical sensors and further investigate unclear parts independently.
10 Take up independent positions about complex situations and be able to defend the point of view.
11 Report on technical or scientific subjects orally, in writing and in graphics.
12 Interpret the manuals of standard photonic instrumentation and work with this instrumentation.
13 Function as a member of an international team.
14 Act in an ethical, professional and social way.

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Practical

Study material

None

References

- "Optics", E. Hecht, Second Edition, Addison-Wesley, 1987.
- "Handbook of Optics – Fundamentals, Techniques & Design, Second Edition", Volume I, M. Bass (ed.), McGraw-Hill, 1995.
- "Optical Waves in Crystals: Propagation and Control of Laser Radiation", A. Yariv and P. Yeh, Wiley-Interscience, 2002.
- "Introduction to Instrumentation, Sensors and Process Control", W. Dunn, Artech House, 2006.
- "Physique des semiconducteurs et des composants électroniques", H. Mathieu, Masson, 1987.
- "Trends in Optical Non-Destructive Testing and Inspection", P. Rastogi and D. Inaudi (eds.), Elsevier, 2003.
- "Optical Measurement Techniques and Applications", P. Rastogi (ed.), Artech House, 1997.
- "The Laser Doppler Technique", L. Drain, John Wiley & Sons, 1980.
- "Optical Sensors – Industrial, Environmental and Diagnostic Applications", N. Narayanaswamy and O. Wolfbeis (eds.), Springer, 2004.
- "Optical Fiber Sensor Technology", K. Grattan and B. Meggitt (eds.), Chapman & Hall, 1995.
- "Optical Fiber Sensor Technology – Volume 2, Devices and Technology", K. Grattan and B. Meggitt (eds.), Chapman & Hall, 1998.
- "Fiber Bragg Gratings – Fundamentals and Applications in Telecommunications and Sensing", A. Othonos and K. Kalli, Artech House, 1999.
- "Fiber Bragg Gratings", R. Kashyap, Academic Press, 1999.
- "Optical Fiber Sensor Technology – Advanced Applications, Bragg Gratings and Distributed Sensors", K. Grattan and B. Meggitt (eds.), Kluwer Academic Publishers, 2000.
- "Fiber Optic Sensors", F. Yu and S. Yin (eds.), Marcel Dekker, 2002.

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

During examination period: exam consisting of a main question to be answered with or without class notes and two smaller questions to be answered without the use of class notes. The answers are first prepared in writing, followed by an oral examination based on the preparation.

During semester: graded lab sessions and poster presentation, the latter being facultative depending on the number of students enrolled.

Calculation of the examination mark

During exam period: exam for 75% of total examination mark.

During semester: graded lab sessions ans poster presentation for 25% of total examination mark.