GHENT UNIVERSITY

# Course Specifications

Valid as from the academic year 2015-2016

## Optical Materials (E024800)

**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 2016-2017**

| | | | |
|---|---|---|---|
| A (semester 1) | English | seminar: coached | 20.0 h |
| | English | lecture | 30.0 h |
| | English | project | 1.25 h |
| | English | seminar: practical | 7.5 h |

**Lecturers in academic year 2016-2017**

| | | |
|---|---|---|
| Neyts, Kristiaan | TW06 | lecturer-in-charge |
| Danckaert, Jan | VUB | co-lecturer |

| **Offered in the following programmes in 2016-2017** | crdts | offering |
|---|---|---|
| Bridging Programme European Master of Science in Photonics | 6 | A |
| Bridging Programme Master of Science in Photonics Engineering | 6 | A |
| Elective Course List European Master of Science in Nuclear Fusion Science and Engineering Physics | 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 |
| Master of Science in Photonics Engineering | 6 | A |
| European Master of Science in Nuclear Fusion and Engineering Physics | 6 | A |
| European Master of Science in Nuclear Fusion and Engineering Physics | 6 | A |
| Master of Science in Photonics Engineering | 6 | A |
| Master of Science in Engineering Physics | 6 | A |

### Teaching languages

English

### Keywords

microscopic, anisotropy, non-linearity, optical properties

### Position of the course

Introducing the microscopic origin of optical phenomena and transferring concepts from microscopic to macroscopic descriptions. Illustrating optical properties like anisotropy, non-linearity and variation by means of electric, elastic, acoustic or magnetic effects in basic components. All lectures are held in Gent, co-lecturer from VUB: Jan Danckaert.

**Contents**

- Introduction: Introduction
- Properties of linear isotropic materials: examples, microscopic theory, definitions
- Light propagation in anisotropic dielectrics: polarisation, propagation, matrix formalism, reflection
- Properties of linear anisotropic dielectrics: tensors, types of materials, optical activity
- Modification of optical properties: microscopic theory, electro- photo- elasto- acousto- magneto- optic effects
- Liquid crystals: types of ordering, switching behavior Non-linear optical materials: second-order effects, phase-relations, OPO, material examples

**Initial competences**

bachelor in applied physics or bachelor in electrotechnical engineering

**Final competences**

1 Understand and explain the microscopic and macroscopic theory of linear (isotropic and anisotropic) optical materials and light propagation.
2 Understand and explain mechanisms for modifying the optical properties of materials: electric, magnetic, elastic and acoustic methods, including liquid crystals.
3 Understand and explain basic non-linear optical effects
4 Solve exercises that are based on linear (isotropic and anisotropic) optical materials, modifcation of optical properties and liquid crystals.
5 Calculate the propagation of light based and the change in polarization with the Jones calculus.
6 Make written and oral reports about an optical phenomenon or device

**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**

Lecture, project, seminar: coached exercises, seminar: practical PC room classes

**Extra information on the teaching methods**

lectures about theory
work sessions: guided exercises, PC practicum, literature study with presentation and report

**Learning materials and price**

English syllabus (identical to syllabus at VUB).

**References**

- Optical Waves in Crystals, A. Yariv and P. Yeh, John Wiley and Sons, New York
- Introduction to Complex Mediums for Optics and Electromagnetics, Weiglhofer and Lakhtakia, SPIE press, Bellingham

**Course content-related study coaching**

Help with solving exercices and with the PC practicum.

**Evaluation methods**

end-of-term evaluation 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

**Extra information on the examination methods**

During examination period:
1. theory exam: closed-book exam with oral examination;
2, problem solving exam: the syllabus can be used.
During semester:
graded project reports; graded oral presentation. Frequency: 1 computerpracticum

(written report): 10%, week 10. 1 literature study (written report and oral presentation): 20%, week 12.

**Calculation of the examination mark**

Special conditions: In the exam period: 70%. During the lecturing time: 10% + 20%. The scores obtained during the lecturing time are transferred to the second exam session.