Non-linear Optics (E023940)

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

Course Specifications
Valid as from the academic year 2015-2016

Lecturers in academic year 2021-2022
Kuyken, Bart
TWOS lecturer-in-charge

Offered in the following programmes in 2021-2022

- **Bridging Programme Master of Science in Photonics Engineering**
  - *crdts*: 4
  - *offering*: A

- **European Master of Science in Photonics**
  - *crdts*: 4
  - *offering*: A

- **Master of Science in Photonics Engineering**
  - *crdts*: 4
  - *offering*: A, O

Teaching languages
English

Keywords
optics, non-linear optics

Position of the course
This course will familiarize the student with the concepts and methods of non-linear optics and with its applications. Through this course the student will be able to start reading the specialized literature and to start research in this field.

This course is taught at UGent in the first semester. A teleclassing system is used to limit the student travel between VUB and UGent.

Contents

- Introduction
- Origin of optical non-linearity: Microscopic model, Resonant and non-resonant non-linearity
- Polarisation and susceptibility: General description of macroscopic polarisation, Symmetry properties of non-linear susceptibility, Non-linear wave equation (slowly varying envelope approximation)
- Second order effects: Coupled wave equations, Phase matching methods, Manley-Rowe, Sum frequency and second harmonic generation, Difference frequency generation and parametric amplification
- Third order effects: Four-wave mixing, Intensity dependent refractive index, Self-focusing, self-phase modulation, bistability, supercontinuum and comb generation
- Non-linear scattering: Spontaneous and stimulated scattering, phonons, Brillouin scattering, Raman scattering

Contact hrs

<table>
<thead>
<tr>
<th>Course size</th>
<th>Study time</th>
<th>Contact hrs</th>
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<tr>
<td>Credits 4.0</td>
<td>120 h</td>
<td>37.5 h</td>
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Course offerings and teaching methods in academic year 2021-2022

- **A (semester 1)**
  - English
  - Gent
  - Seminar: coached exercises 5.0 h
  - Self-reliant study activities 1.25 h
  - Lecture 15.0 h

- **O (semester 1)**
  - English
  - Gent
• Resonant (or indirect) optical non-linearities: non-linearities induced by plasma effect, band filling effects, thermo-optic effect, optical forces etc
• Non-linear optical materials: glasses, semiconductors, ferroelectrics, polymers

Initial competences
In depth knowledge of linear wave propagation, and of linear optical properties of materials.

Final competences
1 Understanding of the most important phenomena in non-linear optics.
2 Knowledge of the most important non-linear materials and understanding of the order of magnitude of typical non-linear effects.
3 Skills in the mathematical treatment of non-linear optics.

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, self-reliant study activities, seminar: coached exercises

Learning materials and price
Non-linear optics: syllabus (in English).

References
• Optical waves in Crystals, Propagation and control of laser radiation door Amnon Yariv en Pochi Yeh

Course content-related study coaching

Evaluation methods
end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period
Open book examination, oral examination

Examination methods in case of periodic evaluation during the second examination period
Open book examination, oral examination

Examination methods in case of permanent evaluation
Skills test

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

Calculation of the examination mark

(Approved)