

Non-linear Optics (E023940)

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

Credits 4.0 **Study time** 120 h **Contact hrs** 37.5 h

Course offerings and teaching methods in academic year 2022-2023

A (semester 1)	English	Gent	self-reliant study activities	1.25 h
			seminar: coached exercises	5.0 h
			lecture	15.0 h

O (semester 1)	English	Gent
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Lecturers in academic year 2022-2023

Kuyken, Bart	TW05	lecturer-in-charge
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Offered in the following programmes in 2022-2023

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

- R.W.Boyd, Non-linear optics, 2nd edition, Elsevier 2003.
- 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 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

During examination period: oral open-book exam, written preparation. During semester: homework assignments.

Calculation of the examination mark