

Nonlinear optics

Lecturer

Pascal KOCKAERT (Coordinator)

Course mnemonic

PHYS-H510

ECTS credits

5 credits

Language(s) of instruction

English

Course period

Second term

Campus

Solbosch

Course content

This course begins with the description of light-matter interactions, on the basis of the constitutive equations appearing in Maxwell equations. After a brief review on linear systems, the nonlinear systems are studied, firstly from a very general point of view (non local, non instantaneous, order n), secondly in the most frequent cases that are encountered in optics: sum and difference frequency generation; nonlinear propagation; Kerr, Raman and Brillouin effects; phase conjugation, self-focusing; four-wave mixing; solitons; metrology of frequencies.

Objectives (and/or specific learning outcomes)

Understand physical mechanisms sustaining optical nonlinear response in matter and use these principles to select and justify the use of a specific nonlinear optical device for a photonic application.

Teaching method and learning activities

Classical course with transparencies and PDF slides. In order to illustrate the theory, exercises are proposed to the students.

Contribution to the teaching profile

- > **modélisation** of a nonlinear system ;
- > **matter physics** : microscopic symmetries, electronic nonlinearities, molecular reorientation,...
- > **photonics** : basic mechanisms for applications, such as frequency conversion, nonlinear spectroscopy, mode-locking, signal characterization, ...
- > **multidisciplinary problem solving** : link between mathematical models and experimental devices ;
- > **group working**, at the laboratory

References, bibliography and recommended reading

Among references that are available through the library of the university the following ones could be of some help :

- ¹ « Nonlinear Optics », Boyd, 3eme ed., available at <http://www.sciencedirect.com.ezproxy.ulb.ac.be/science/book/9780123694706>
- ² « Applications of nonlinear fiber optics », Agrawal, 2eme ed., available at <http://www.sciencedirect.com/science/book/9780123743022>
- ³ « Extreme nonlinear optics », Wegener, available at <https://link.springer.com.ezproxy.ulb.ac.be/book/10.1007%2Fb137953>
- ⁴ « Nonlinear optical crystals : A complete survey », Nikogosyan, available at <https://link.springer.com.ezproxy.ulb.ac.be/book/10.1007/b138685>
- ⁵ « Crystallography and the world of symmetry », Chatterjee, available at <https://link.springer.com.ezproxy.ulb.ac.be/book/10.1007/978-3-540-69899-9>

Course notes

Université virtuelle

Other information

Place(s) of teaching

Solbosch

Contact(s)

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Evaluation method(s)

Oral examination and Written report

Evaluation method(s) (additional information)

Oral exam.

Determination of the mark (including the weighting of partial marks)

Theory 60%, Lab and exercises 40%.

Main language(s) of evaluation

English

Other language(s) of evaluation, if applicable

French

Programmes

Programmes proposing this course at the
Brussels School of Engineering

MA-IRPH | **Master of science in Physical Engineering** | finalité
Professional/unit 2

