High Speed Photonic Components (E030630)

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	group work
			independent work

Lecturers in academic year 2025-2026

Morthier, Geert	TW05	lecturer-in-charge
Verschaffelt, Guy	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

modulation, optical pulses, optical switching

Position of the course

To acquire a thorough understanding of the dynamics of laser diodes . To acquire an overview of the field as well as the necessary insight and skills to be able to do research or follow-up research in the field. Partly taught at UGent and partly at VUB.

Contents

- Introduction: Components, General approximations, Applications
- Laser diode desciptions: Longitudinal equations, Rate equation descriptions, Non-linear material properties
- Laser diode modulation and noise: Small signal modulation, large signal modulation, Linewidth and intensity noise, External feedback, Experimental characterisation
- Non-linear laser dynamics: bifurcations, Chaos and its characterisation
- Mode locking and short pulse generation: Mode locking theory, Q-switching and self-pulsations, Characterisation of short pulses
- Capita selecta: laser diodes with very high modulation bandwidth, external modulators, all-optical flip-flops

Initial competences

wave propagation theory, laser theory, notions of noise.
This course relies heavily on several competences acquired in the course Lasers. It is not adviced to take this course without first having taken the course Lasers (or having acquired a thorough knowledge about lasers).

Final competences

1 Being able to use the rate equations for the derivation of large and small signal dynamic behaviour.
2 Being able to derive the different noise characteristics from the rate equations.
3 Understanding the different methods for the generation of short laser pulses.
4 Understanding the influence of external reflections on the laser diode behaviour.
5 Understand the context of sicentific or technical documents in the field of photonics and further investigate unclear parts independently.

6 Acquire sufficient knowledge to perform research in the domain of laser dynamics.

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

Group work, Lecture, Independent work

Study material

Type: Syllabus

Name: High speed photonic components
Indicative price: Free or paid by faculty
Optional: no
Language : English
Oldest Usable Edition : NA
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

- Petermann, K.; Laser Diode modulation and noise
- Agrawal, G.P.; Long wavelegnth semiconductor lasers
- San Miguel M. and Toral R.; Stochastic effects in physical systems, arXiv:cond-mat/9707147v1, 14 july 1997

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

Examination methods in case of periodic assessment during the second examination period

Oral assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

During examination period: oral closed-book exam, written preparation. During semester: graded project reports; graded team work.

Calculation of the examination mark

Special conditions: 1 computer exercise and 1 paper. Final score depenss half on the marks for these exercises (1/4th per exercise).