

## High Speed Photonic Components (E030630)

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

**Credits** 4.0      **Study time** 120 h      **Contact hrs** 67.5 h

**Course offerings and teaching methods in academic year 2022-2023**

A (semester 1)	English	Gent	guided self-study	15.0 h
			group work	2.5 h

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

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

**Offered in the following programmes in 2022-2023**

	<b>crdts</b>	<b>offering</b>
<a href="#">Bridging Programme Master of Science in Photonics Engineering</a>	4	A
<a href="#">European Master of Science in Photonics</a>	4	A
<a href="#">Master of Science in Photonics Engineering</a>	4	A, O

**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 descriptions: 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
- All-optical flip-flops: Flip-flops based on DFB lasers, Flip-Flops based on ring or disk lasers

**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 advised 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 scientific 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

Guided self-study, group work, lecture

## Learning materials and price

lecture notes (jointly with VUB)

## References

- Petermann, K.; Laser Diode modulation and noise
- Agrawal, G.P.; Long wavelength 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

## Evaluation methods

end-of-term and continuous assessment

## Examination methods in case of periodic evaluation during the first examination period

Oral examination

## Examination methods in case of periodic evaluation during the second examination period

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 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 depends half on the marks for these exercises (1/4th per exercise).