

## Micro- and Nanophotonic Semiconductor Devices (E030782)

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

<b>Course size</b>	<i>(nominal values; actual values may depend on programme)</i>			
<b>Credits 4.0</b>	<b>Study time 120 h</b>	<b>Contact hrs</b>	60.0h	
<b>Course offerings and teaching methods in academic year 2021-2022</b>				
A (semester 2)	English	Gent	seminar: coached exercises	5.0h
			project	5.0h
			lecture	30.0h
O (semester 2)	English	Gent		

### Lecturers in academic year 2021-2022

Van Thourhout, Dries TW05 lecturer-in-charge

### Offered in the following programmes in 2021-2022

	<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

Photonics, Semiconductor, Heterojunctions, nanotechnology, Sources, detectors, modulators, quantum dot, quantum wire

### Position of the course

The student will acquire an advanced theoretical framework (mathematical and quantum-mechanical tools) to design optoelectronic devices. He will get insight in the band structures of semiconductors and how they change in structures with reduced dimensions. He/she will get insights in the newest technologies to develop novel devices for the future. He/she will learn the operation principles of a large set of photonic devices such as detectors, light sources, modulators and others. The course will be a solid base to understand the operation of micro and nanophotonic semiconductor devices of today, and will allow students to design novel devices for future photonic applications.

### Contents

The course is divided into three arts: a) Physics of semiconductors for photonic applications b) Photonic Semiconductor Devices and c) Micro and nano-technologies.

- \* Basic properties of semiconductors: Introduction, Comparative study of whole set of semiconductors
- \* Electron wave functions in semiconductors: dispersion relations
- \* Heterostructures: Lattice matched and pseudomorphic structures, Quantum confinement
- \* Phonons: optical, acoustical; transverse, longitudinal
- \* Optical transitions: Fermi's Golden Rule, direct and indirect absorption processes, free carrier absorption, phonon absorption
- \* Crystal- en epitaxial growth: Crystal Growth, Epitaxial Growth
- \* Definition of nano structures: bottom up and top down technologies
- \* Sources: LED, Lasers (Gain, non-parabolic effects, strain effects)

- \* Detectors: PIN, Avalanche, SiGe, Infrared, Metal-Schottky, Quantum Well IR, Quantum Dot IR, Thermal, Seebeck detectors
- \* Modulators: Electro-absorption, quantum confined stark effect, electro optic modulation
- \* Advanced photonic semiconductor components: Quantum dots, wires, quantum cascade lasers ...

### **Initial competences**

Basic knowledge quantum physics  
 Basic knowledge semiconductor physics

### **Final competences**

- 1 Have insight in the operation of advanced photonic semiconductor components.
- 2 Being able to design basic semiconductor components.
- 3 Understand some advanced techniques for the fabrication of photonic semiconductor components.

### **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, Project, Seminar: coached exercises

### **Learning materials and price**

Book "Physics of Optoelectronic Devices" (see below) - available electronically through UGent library

### **References**

- "Essentials of Semiconductor Physics", Tom Wenckebach
- "Physics of Optoelectronic Devices", Shun Lien Chuang

### **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 examination

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

Oral examination

### **Examination methods in case of permanent assessment**

Report, Oral examination

### **Possibilities of retake in case of permanent assessment**

examination during the second examination period is possible in modified form

### **Extra information on the examination methods**

During examination period: written open-book exam with oral defense; written open-book exam - problems  
 During semester: graded project reports.

### **Calculation of the examination mark**

Project at the beginning of second half of semester. The final report of this assignment will be evaluated during an oral discussion. A partial exemption can be obtained for a maximum of 35% of the grand total. At the end of the semester - an oral examination, prepared in a written way with a minimum of 65% of the grand total with open book will be organized.