Optoelectronics

Optoelektronik
6 credits

Programme course

TFYA38

Valid from: 2023 Spring semester

Determined by	Main field of study	
Board of Studies for Electrical Engineering, Physics and Mathematics	Electrical Engineering, Applied Physics, Physics	
Date determined	**Course level**	**Progressive specialisation**
2022-08-31	Second cycle	A1X
Revised by	**Disciplinary domain**	
	Natural sciences	
Revision date	**Subject group**	
	Physics	
Offered first time	**Offered for the last time**	
Spring semester 2008		
Department	**Replaced by**	
Institutionen för fysik, kemi och biologi		

Course offered for

- Master of Science in Electronics Design Engineering
- Master of Science in Applied Physics and Electrical Engineering
- Master of Science in Applied Physics and Electrical Engineering - International
- Master's Programme in Materials Physics for Nano and Quantum Technology

Prerequisites

Basic knowledge in modern physics or nanotechnology.

Intended learning outcomes

The overall aim of this course is to give fundamental knowledge of optoelectronic devices and fiber optics in order to be able to understand present and future technologies for applications in optical communications, sensor/imaging techniques, as well as energy conversion that has found renewed interest recently due to world-wide demands of energy saving and new energy production. After completing this course, students are expected to do the following:

- Know various physical processes of optoelectronic transitions, and be able to employ basic relations between material optical properties and devices in optoelectronics.
- Define the principles of functioning of most important optoelectronic devices.
- Explain and implement the equations, which determine main characteristics of optoelectronic devices and optical fibers.
- Apply the knowledge of different optoelectronic components to solve problems mainly in the physics and technical areas.
- Analyze operational modes of photonic devices, in order to select suitable type for given applications.
- Understand the interconnections between device design, mode of operation and characteristics, and the overall efficiency of optoelectronic devices and signal transmission.
- Calculate parameters and design simple systems for optical communication or energy conversion

Course content

- Physics fundamentals
    - Electromagnetic wave physics, optics, Maxwell and Fresenel equations
    - Quantum mechanical physics, semiconductors, Einstein relations
- Electron–photon processes
    - Carrier radiative recombination and light-emitting-devices (LED)
    - Stimulated processes, lasing mechanism, and modes
    - Semiconductor laser
- Photon–electron processes
    - Photoconductivity and detectors
    - Imaging sensors
    - Photovoltaic effect and solar cells
- Photon–photon processes and integration
    - Electromagnetic wave propagation, waveguide, and fiber optics
    - Light polarization and modulation
    - Optical systems for communication
    - Photonic lattice and other low-dimensional materials for optoelectronic applications
- Complement technologies and future outlook
    - Organic and molecular optoelectronics
    - Terahertz photonics
    - Display technology
    - Impact from nanotechnology - new think, materials, and other perspectives

Teaching and working methods

The course will be given in the form of lectures, problem solving classes, as well as laboratory experiments in small groups. Home-assignments are also included.

Examination

KTR1	Quiz tests	0 credits	U, G
UPG1	Homework assignments	1 credits	U, G
LAB2	Laboratory work	1 credits	U, G
TEN2	A written examination	4 credits	U, 3, 4, 5

The exam controls the students ability to solve numerical problems and perform calculations for the design of components. The laboratory work gives the student training in practical testing of optoelectronic components.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

About teaching and examination language

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is “Swedish”, the course as a whole could be given in Swedish, or partly in English. Examination language is Swedish, but parts of the examination can be in English.
- If teaching language is “English”, the course as a whole is taught in English. Examination language is English.
- If teaching language is “Swedish/English”, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English depending on teaching language.

Other

The course is conducted in a manner where both men's and women's experience and knowledge are made visible and developed.

The planning and implementation of a course should correspond to the course syllabus. The course evaluation should therefore be conducted with the course syllabus as a starting point.

The course is campus-based at the location specified for the course, unless otherwise stated under “Teaching and working methods”. Please note, in a campus-based course occasional remote sessions could be included.

If special circumstances prevail, the vice-chancellor may in a special decision specify the preconditions for temporary deviations from this course syllabus, and delegate the right to take such decisions.