Optoelectronics

Programme course

6 credits

Optoelektronik

TFYA38

Valid from: 2020 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2019-09-23

Main field of study
Electrical Engineering, Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Master's Programme in Biomedical Engineering
- Master's Programme in Physics and Nanoscience
- Master's Programme in Materials Science and Nanotechnology
- Physics and Nanoscience, Bachelor's Programme
- Electronics Design Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

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 or in large parts, is taught in Swedish. Please note that although teaching language is Swedish, parts of the course could be given in English. Examination language is Swedish.
- 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).
- If teaching language is English, the course as a whole is taught in English. Examination language is English.

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.

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Boman

Examiner

Wei-Xin Ni

Course website and other links

http://www.ifm.liu.se/undergrad/fysikgtu/coursepage.html?selection=all&sort=kk

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

S.O. Kasap: "Optoelectronics and Photonics",ISBN 0-201-61087-6; 2001, Prentice-Hall, Inc., New Jersey. Alternativ: P. Bhattacharya: "Semiconductor Optoelectronic Devices" (Prentice Hall) Laborationshandledningar (2 st) kan laddas ner från kursens hemsida.