Faculty of Science

FYSD23, Physics: Processing and Device Technology, 7.5 credits

Fysik: Process- och komponentteknologi, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2021-12-08 to be valid from 2021-12-08, autumn semester 2022.

General Information

The course is an elective course for first-cycle studies for a Bachelor or Master's degree (120 credits) in physics.

Language of instruction: English
If needed, the course is given in English.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The purpose of the course is for the students to acquire basic knowledge in fabrication and characterisation of semiconductor devices. Focus will be on modern materials and process technologies with a clear emphasis on nanotechnology. Most of the processes are general and are used in silicon-based IC-technology, solar cells, III-V devices (e.g. LEDs/lasers), as well as in electro-mechanical systems.

Knowledge and understanding

After completing the course, the student shall be able to:

- describe fabrication processes that are based on surface patterning, thin film deposition, etching and doping
- explain how such processes can be implemented on the nanometer scale
- explain connections between choice of material/fabrication process and the function and performance of a device.

Competence and skills
After completing the course, the student shall be able to:

- carry out basic semiconductor processing in a clean room environment
- analyse a specific device and decide which processing steps that are required to produce it
- write a well-structured technical report about semiconductor processing.

Judgement and approach
After completing the course, the student shall be able to:

- reflect on obtained results and on how a result may have been affected by limitations in theoretical models and experimental setups
- critically discuss and assess various challenges related to the industrial evolution in the field and the need for innovations.

Course content

The course treats:

- Growth of semiconductor crystals of different materials and wafer formation - the starting point for semiconductor processing.
- Cleanroom technology - function and purpose of a cleanroom.
- Epitaxy of semiconductors, including heterostructures.
- Lithography - methods for wafer patterning using UV-light and/or electrons.
- Semiconductor/insulator interfaces (MOS structures) and how these can be formed by oxidation and deposition.
- Methods for depositing thin films of insulators and metals.
- Etching: Wet and dry, using acids/bases and plasmas.
- Doping: How small amounts of impurity atoms are introduced in a semiconductor crystal through diffusion or implantation.
- Integrating mechanics and electronics: acceleration meters and other mechanical functions within a chip.
- Process integration - why CMOS is so successful and how the billions of transistors in a CPU can properly function.
- How LEDs, solar cells, electronic memories, light sensors and lasers are fabricated and operate.

Some of the processes will be used in a series of laboratory sessions to fabricate functioning devices. Since fabrication of semiconductor devices is extremely sensitive and requires a controlled environment, a strong focus will be on learning how to work inside a cleanroom.

Course design

The teaching consists of lectures, laboratory sessions and exercises. Participation in laboratory sessions and other teaching integrated with that is mandatory.

Assessment

The examination consists of a written exam at the end of the course and laboratory exercises with corresponding reports during the course. For students who do not pass the regular examination, an additional examination is offered during the scheduled re-examination period.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the course, approved examination and approved laboratory reports and participation in all compulsory parts are required.

The grading scale on the written examination are Fail, Pass, Pass with distinction. Grading scale on the laboratory exercises and compulsory parts are Fail and Pass. The written examination corresponds to 5.5 credits, and completion of the laboratory part of the course to 2 credits.

The final grade is decided by the the grade on the written examination.

Entry requirements

Admission to the course requires 120 hp studies in natural sciences, of which 75 credits in physics and 45 credits in mathematics is included, alternatively a Bachelor degree in physics – in both cases including knowledge equivalent to FYSC23 Solid State Physics, 7.5 hp, and English 6/B.

Further information

The course cannot be included in a degree together with FYSD13 Physics: Processing and Device Technology, 7,5 hp.

The course is to be studied together with FFFF10 Processing and Device Technology, 7,5 credits, which is coordinated by LTH.

The written exam is scheduled according to exam schedule of LTH.

Subcourses in FYSD23, Physics: Processing and Device Technology

Applies from H22

2201 Written exam, 5,5 hp
Grading scale: Fail, Pass, Pass with distinction
Processing and Device Technology
2202 Laboratory Exercises and Report, 2,0 hp
Grading scale: Fail, Pass