Faculty of Science

FYST60, Physics: Advanced Processing of Nanostructures, 7.5 credits

Fysik: Avancerad framställning av nanostrukturer, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

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

General Information

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

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is that students, after completing the course, will have acquired in-depth knowledge in the fabrication and characterization of nanoscale devices, intended for use in nanoelectronics as well as in the life sciences. The focus will be on modern material and process techniques currently used in nanotechnology, such as electron beam lithography, scanning electron microscopy, etching, etc. In the laboratory part of the course, the students will have access to a modern cleanroom to make structures and devices using the various process techniques mentioned above.

Working with nanometer-scale structures takes place in a clean and dust-free environment, therefore working methods and safety issues in cleanrooms are important elements of the course.

Knowledge and understanding
On completion of the course, the students shall be able to:

- explain and describe different process technologies and how they can be realised in the field of nanotechnology
- describe the structure of a cleanroom
- explain the importance of work methodology in a cleanroom.

Competence and skills
On completion of the course, the students shall be able to:

- independently perform advanced processing in a clean room environment
- design simple devices and write a detailed process flow for their manufacture
- write well-structured technical reports on semiconductor processing
- present results to colleagues

Judgement and approach
On completion of the course, the students shall be able to:

- demonstrate an understanding of the necessity of cleanroom and good cleanroom discipline for the fabrication of components and circuits at the nanoscale in the first place.

Course content

The course consists of two parts:

Lectures begin with basic cleanroom design, classification of cleanroom standards, different sources of particulate pollution, and airflow and air filtration in cleanrooms. Different types of cleanrooms are discussed with a focus on semiconductor and nanotechnology applications. Handling of chemicals and safety aspects of laboratory work will be addressed in the context of the practical exercises in cleanrooms.

In the second and most important part of the lectures, different methods for lithography-based nanofabrication will be discussed in detail. In particular, the lectures will cover electron beam lithography, focused ion beams, nanoimprint and self-assembly in the context of modern nanofabrication methods. The most common steps in the fabrication of nanostructures and devices, such as lift-off, etching and deposition, will also be presented. This knowledge will then be directly applied later in the laboratory part of the course.

Course design

The teaching consists of lectures, laboratory sessions and project work. Participation in laboratory and project work and other integrated teaching is compulsory.

Assessment

Examination is in the form of a written exam in the middle of the course and through laboratory work and project work during the course. For students who do not pass the regular examination, an additional examination is offered during the scheduled re-examination period. The labs and the course project must be passed in order to successfully complete the course.

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.
For a grade of Pass on the whole course, the student must have passed the exam, laboratory and project reports and participated in all compulsory parts. The grading scale for the written examination is Fail, Pass, Pass with distinction, while the laboratory and project work are graded according to the grading scale Fail, Pass.

The final grade is determined by the grade of the examination.

Entry requirements

To be admitted to the course, students must have 135 credits in Natural Science studies, including 90 credits in physics and 45 credits in mathematics, or a Bachelor's Degree in physics - in both cases including knowledge equivalent to FYSC23 Solid State Physics, 7.5 credits and FYSD23 Process and Component Technology, 7.5 credits and English 6/B.

Further information

The course may not be included in a degree together with FYST31 Physics: Advanced Fabrication of Nanostructures, 7.5 credits.

The course is co-taught with FFFN01 Advanced Processing of Nanostructures, 7.5 credits which is a course at LTH.

The examination of the course is scheduled according to the LTH examination scheme.

Subcourses in FYST60, Physics: Advanced Processing of Nanostructures

Applies from H22

2201 Exam, 3,0 hp
Grading scale: Fail, Pass, Pass with distinction
2202 Project, 4,5 hp
Grading scale: Fail, Pass