Faculty of Science

FYST51, Physics: Modern X-ray Physics - Diffraction and Imaging, 7.5 credits

Fysik: Modern röntgenfysik - diffraktion och avbildning, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2017-09-25 to be valid from 2017-09-25, autumn semester 2018.

General Information

The course is an elective course for second cycle studies for a scientific Bachelor's or Master's degree 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 course gives a solid introduction to the interaction of X-rays with matter and its applications with an emphasis on diffraction and mapping.

Knowledge and understanding

On completion of the course, the student shall be able to:

- explain the interaction of X-rays with matter on the atomic scale
- describe the principles behind X-ray detectors and X-ray optics and common implementations of these
- explain the dispersion of X-rays in non-crystalline and crystalline materials
- describe the principles of diffraction and the relationship between the direct and the reciprocal space
- explain how the interaction of X-rays with matter can be utilised for different imaging methods.

Competence and skills

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

- calculate the absorption and spreading of X-rays in matter
- integrate the knowledge received in this course in a scientific discussion.

Course content

- X-ray sources
- Dispersion and absorption
- Refraction and reflection in interfaces, refractive index.
- X-ray optics
- Dispersion from non-crystalline materials, small angle X-ray scattering (SAXS).
- Dispersion from crystalline materials: X-ray diffraction (XRD), Fourier transform, the reciprocal space, the Ewald sphere.
- Scanning X-ray diffraction, surface X-ray diffraction
- Photoelectric absorption, X-ray absorption spectroscopy (XAS/EXAFS)
- X-ray fluorescence (XRF), emission spectroscopy, scaninng X-ray fluorescence spectroscopy (XRF)
- X-ray detectors
- X-ray mapping: scaninng transmission, tomography
- Coherent X-ray mapping: Phase contrast, phase retrieval, holography, ptychography

Course design

The teaching consists of lectures, laboratory sessions, group work and project work. Participation in the laboratory sessions and associated elements is compulsory.

Assessment

Examination takes place in the form of a written exam, written assignments, assessment of project report and through compulsory components.

Students who do not pass a regular assessment will be offered another opportunity for assessement soon thereafter.

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.

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 entire course, an approved exam, passed written assignments and

participation in all compulsory parts are required. The final grade is determined by weighing togther the results in the different parts of the examination.

Entry requirements

The course is an elective second cycle for a Master of Science degree in physics, and related to the engineering program (technical nanoscience, and theoretical physics), along with doctoral students in the related fields. The course is open to students from other programmes, provided that they have the sufficient qualifications/prior knowledge. The course requires prior knowledge in physics at university level in the form of fundamental atomic physics, electromagnetism and optics.

Subcourses in FYST51, Physics: Modern X-ray Physics - Diffraction and Imaging

Applies from V19

1901 Examination, 3,0 hp
Grading scale: Fail, Pass, Pass with distinction
1902 Hand-in assignment, 3,0 hp
Grading scale: Fail, Pass, Pass with distinction
1903 Laboratory work, 1,5 hp
Grading scale: Fail, Pass, Pass with distinction