Faculty of Science

MAXC21, Photon and Neutron Production for Science, 7.5 credits

Produktion av fotoner och neutroner för vetenskap, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2024-12-09. The syllabus comes into effect 2024-12-09 and is valid from the autumn semester 2025.

General information

The course is an elective course in the first cycle for a Bachelor of Science in physics.

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

Main field of study	*Specialisation*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Learning outcomes

On completion of the course, the student is to have acquired general knowledge in accelerators and how photons and neutrons are produced for scientific use. The student also will get a solid base for further studies towards instruments, beamlines and experimental methods used at large facilities such as MAX IV and ESS.

Knowledge and understanding

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

- describe the basic concepts used in accelerator physics
- explain different accelerator types and their way of operation
- explain how photons are produced in synchrotrons

- explain how neutrons are produced, especially in spallation sources
- name the principal techniques used in X-rays and neutrons science
- illustrate and discuss the use of photons and neutrons in research.

Competence and skills

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

- describe and apply the basic concepts of particle beam transport
- use the basic relations in beam dynamics
- present an accelerator-based user facility
- discuss the transport of light in a beamline
- carry out a comparison between neutron sources
- report on neutron sources and their performance.

Judgement and approach

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

- critically discuss the motion of charged particles in simple magnetic lattices
- critically discuss the properties of the synchrotron radiation.

Course content

The course provides specialised knowledge of how photons and neutrons are produced with accelerators and how they are used in research.

Different types of accelerators are introduced, with special emphasis on synchrotrons and linear proton accelerators. The lectures give an overview of the different components (magnets, RF cavities, vacuum, diagnostics) of an accelerator and the basic theory of beam dynamics is introduced. A more specific description is dedicated to synchrotron light sources and spallation neutron sources.

Beamlines for photons are presented and described in detail, as well as the function and structure of neutron guides. Experimental stations and instruments used in research facilities are introduced and finally research methods and their applications in natural science, medicine and material science are presented.

Course design

The teaching consists of lectures, study visits, seminars, computational and group exercises and project work. The knowledge is strengthened with exercise sessions and simulation sessions. The submission of hand-in assignments is compulsory.

Assessment

The examination consists of a written exam and an oral exam at the end of the course.

Students who do not pass the regular exam are offered a re-examination shortly after the regular exam.

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.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the final written examination and oral exam is Fail, Pass and Pass with distinction.

To pass the entire course it is necessary to pass the written and the oral examination and full-fill the compulsory components.

The grade for the whole course is determined by an aggregation of the grades of the written and oral examination.

The pass mark is 55% and the mark for pass with distinction is 85%.

Entry requirements

To be admitted to the course, students must have at least 60 credits in mathematics and/or physics, and proficiency in English equivalent to English 6/B.

Further information

The course replaces MAXC11, Photon and neutron production for science, 7.5 credits and credits from that course cannot count towards a degree together with this course, or together with MAXM07, Introduction to Accelerator Physics and Free Electron Lasers, 7.5 credits.

The course is studied together with EXTF90, Photon and Neutron Production for Science, 7.5 credits, which is a course at Lund University's Faculty of Engineering, LTH.

The course is assessed according to the Faculty of Science exam schedule.

The course is offered at the department of Physics, Lund University.