Faculty of Science

MAXG35, Fundamentals of Accelerator Technology, 3 credits

Grundläggande acceleratorteknik, 3 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2016-06-19 and was last revised on 2016-06-19. The revised syllabus applies from 2016-06-19, spring semester 2016.

General Information

The course is an elective first-cycle component of a Bachelor of Science degree specialising in Physics

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is to provide students with fundamental knowledge about accelerator technology, and understanding and inspiration with regard to their opportunities for development in the field.

Knowledge and understanding

For a Pass on the course, the students shall be able to

1) describe the physical and technological construction of linear particle accelerators, storage rings and synchrotron radiation

2) understand the differences between different types of accelerators

3) have knowledge of some of the simulation devices used within accelerator technology and judge what they can be used for

4) discuss how particle accelerators can be used within different fields such as biomedicine, materials science and elementary particle physics.

Competence and skills

For a Pass on the course, the students shall be able to

5) calculate the trajectories of relativistic particles and some beam parameters such as emittance using numerical simulation tools

6) perform simple analytical calculations to determine the energy and trajectories of of charged particles in electromagnetic fields

7) make simple estimates of the strength of the magnetic fields in dipole and quadrupole magnets.

Judgement and approach

For a Pass on the course, the students shall be able to

8) relate costs to benefits of different types of accelerators. This is particularly important for accelerators used in medical contexts, e.g. proton therapy.

Course content

Introduction to basic accelerator physics including classical mechanics, electrodynamics and special relativity; description of linear accelerators, storage rings for generating radiation, spallation sources and colliders; overview of microwave systems, resistive and superconducting magnets, cryogenic systems, vacuum systems, power supply; particle beam physics: longitudinal and transverse beam dynamics, synchrotron radiation, nonlinear radiation physics, the magnetic system of storage rings, calculation methods for radiation physics; use of accelerator technology in nuclear and particle physics, materials science, medicine and biology; overview of new accelerator technologies based on powerful lasers in plasma. Major emphasis is placed on information about the accelerators at MAX IV and ESS.

Course design

The teaching consists of lessons, exercises, projects and study visits, distributed over approximately 10 days. In addition, social activities will be included.

Assessment

The assessment is based on a compulsory project that is to be reported in speech and writing.

The students are to solve and submit assignments electronically (e.g. via Moodle).

Grades

Marking scale: Fail, Pass.
For a grade of Pass on the whole course, the student must have passed the oral and written report of the project and the electronic assignments.

Entry requirements

To be admitted to the course, students must have basic mathematical knowledge of analysis in one and several variables and of linear algebra, and have passed one basic course in physics covering mechanics and electromagnetic fields.

Further information

The course is offered in the summer, in parallel with course TFRG35 Fundamentals of Accelerator Technology, 3 credits, at the Faculty of Engineering and may not be included in a degree together with this course. The course is offered in collaboration with MAX IV Laboratory and ESS.