LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Acceleratorer och frielektronlasrar
Accelerators and Free Electron Lasers

EXTN95, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED N
Date of Decision: 2023-04-17

General Information

Elective for: F4, F4-axn
Language of instruction: The course will be given in English

Aim

The aim of the course is to give deepened knowledge in the physics of accelerators and experience in both calculations and modeling of accelerator systems. In addition the course aims at providing a fundamental understanding of the Free Electron Laser and its accelerator systems.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- have knowledge of different types of accelerators and the way of operation.
- be able to understand and use beam dynamics for accelerators
- have understanding of accelerators for synchrotron radiation.
- have understanding of Free Electron lasers and different types of FELs.
- have knowledge of the layout and operation in an accelerator laboratory.

Competences and skills
For a passing grade the student must

- have knowledge of and be able to use the basic physical methods relevant for accelerators and FELs.
- have knowledge of and under supervision be able to perform simpler simulations of accelerators.

Contents

The course focuses on accelerators for synchrotron radiation production (linear accelerators and synchrotrons), their mode of operation and layout and how their properties connect to different areas of use.
Different accelerator components are analyzed (electron guns, linear accelerators, storage rings, diagnostics). The theory for magnets (dipole, quadrupole and general magnets) and how these are used in beam dynamics (particle optics, focusing, matrix formalism, betatron oscillations, beta functions, betatron tunes, emittance etc.) is described. This is used to build simulation models of accelerators. Basic notions of beam instabilities are presented. Synchrotron radiation sources and characteristics are described in more details. The Free Electron Laser (FEL) process and different types of FELs (SASE, cavity FEL, harmonic generation, high gain harmonic generation and seeding) are analyzed and the physics behind amplification is described.

Examination details

Grading scale: UV - (U,G,VG) - (Fail, Pass, Pass with Distinction)
Assessment: Examination with written and oral components, passed laboratory excercise and hand-in exercises. Participation in the experimental work is compulsory. The final grade for the course is determined by the aggregated results of the different parts of the examination.

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.

Admission

Assumed prior knowledge: EXTF90 Photon and Neutron Production for Science.
The number of participants is limited to: No
The course might be cancelled: If the number of applicants is less than 5.

Reading list

- According to a list established by the department and available at least five weeks before the start of the course, see https://liveatlund.lu.se/departments/max-lab/MAXM05/Pages/default.aspx.

Contact and other information

Course coordinator: Sverker Werin, sverker.werin@maxiv.lu.se
Course coordinator: Francesca Curbis, Francesca.Curbis@maxiv.lu.se
Course homepage: https://www.lunduniversity.lu.se/lubas/i-uoh-lu-MAXM05/
Further information: The course is given by the Faculty of Science and does not follow the study period structure.