# ED2235 Atomic Physics for Fusion 6.0 credits

## Atomfysik för fusion

This is a translation of the Swedish, legally binding, course syllabus.

## Establishment

The official course syllabus is valid from the autumn semester 2024 in accordance with the decision
from the director of first and second cycle education: J-2024-0525. Decision date: 2024-04-16.

## Grading scale

A, B, C, D, E, FX, F

## Education cycle

Second cycle

## Main field of study

Electrical Engineering, Physics, Engineering Physics

## Specific prerequisites

- Knowledge in basic mechanics, 6 credits, corresponding to completed course SK1108/SG1112.
- Knowledge in electromagnetic field theory, 9 credits, corresponding to completed course EI1220/EI1320.
- Knowledge in introduction to modern physics, 6 credits, corresponding to completed course SH2008.

Anyone who meets the special entry requirements for the Master's programme in Electromagnetics, Fusion and Space Engineering is considered to meet the above requirements.

Active participation in a course offering where the final examination is not yet reported in Ladok is considered equivalent to completion of the course.
Registering for a course is counted as active participation.
The term 'final examination' encompasses both the regular examination and the first re-examination.

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

After passing the course, the student should be able to

- explain physics for atomic collisions regarding dominating mechanisms in processes as elastic scattering, ionisation, excitation and charge exchange, and give an account of atomic structure and equilibria in plasma at a general level
- make intuitive assessments of relevant magnitudes time scales, energy dependencies etc in fusion relevant atomic processes
- see and give an account of the role of atomic collisions in fusion plasma physics and plasma surface interactions
- use databases and semiempirical formulae for atomic physics data, such as cross-sections and rate coefficients and for derived units as stopping cross-sections and sputtering yield
- use atomic physics data in numerical modelling of plasma phenomena.

## Course contents

- Short overview of quantum mechanics and atomic structure.
- Atomic collisions, cross-sections, rate coefficients.
- Elastic collisions, classical and wave mechanical.
- The Born approximation.
- Interatomic potentials.
- The Thomas-Fermi model.
- A universal interatomic potential.
- Plasma resistivity.
- Stopping cross-sections, sputtering and backscattering at surfaces.
- Inelastic collisions with classical and semiclassical model.
- Ionisation, recombination, charge exchange, and Bremsstrahlung.

- Effective Z, radiation losses, equilibria, transport and energy confinement time.
- Use of data for atomic processes in models that treat fusion plasma physics problems.

## Examination

- ANN1 - Assignments - Individual, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Written exam, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- ANN2 - Assignments - Group, 1.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.