Faculty of Science

# FYST14, Physics: Atomic and Molecular Spectroscopy, 7.5 credits

*Fysik: Atom- och molekylspektroskopi, 7,5 högskolepoäng*

**Second Cycle / Avancerad nivå**

## Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-03-01 to be valid from 2007-07-01, autumn semester 2007.

## General Information

The course is an elective course for second-cycle studies for a scientific candidate and Master's degree (120 credits).

*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 intends to provide theoretical and practical knowledge of the many powerful methods, as modern atom and molecular spectroscopy offer respect both basic studies and practical applications.

*Knowledge and understanding*

To pass the course, the student should:

- be able to account for spectroscopic methods in different energy intervals
- be able to describe the most common components in spectroscopic equipment for different energy intervals
- be able to more elaborately explain quantum mechanics and its description of nature

- describe a consolidated image of quantum mechanics and atomic physics and its relation to classical physics

*Skills and abilities*

To pass the course, the student should

- be able to assess which spectroscopic method that is applicable in a given situation
- be able to assess magnitudes for many physical phenomena
- be able to work practically with optical components and lasers.
- have increased experience to work in a small groups for a joint aim.
- have increased ability to present project that they have carried out in writing.
- had shown ability to make technology assessment of new industrially relevant technology in the form of a written reports
- look after and integrate knowledge from English reference literature

Judgement and approach

To pass the course, the student should:

- be able to assess how spectroscopy can be used as a powerful tool within science and technology.

## Course content

The aim of the course is to provide knowledge in modern atom and molecular spectroscopy with special emphasis on practical applications. Overview of atomic and molecular structure implying a specialisation especially regarding molecules. Radiation and scattering processes: resonant radiation, Rayleigh-, Raman- and Mie-scattering. Spectroscopy of inner electrons: X-ray- and photoelectron spectroscopy (ESCA), synchrotron radiation. Optical spectroscopy: sources of light, spectrally dispersive devices, detectors, optical analytical methods. Resonance methods: atomic beam resonance, optical resonance spectroscopy, electron and nuclear spin resonance. Tuneable lasers: Different types of lasers, single mode operation, high power lasers, peripheral equipment. Laser spectroscopy: time-resolved spectroscopy and high-resolution Doppler-free techniques. Orientation in ultrafast spectroscopy, high power laser systems cooling and interception of atoms and ions. Laser spectroscopic applications: remote sensing of air and water pollutions, combustion and reactions diagnostics, laser-driven chemical reactions, isotope separation, medical applications. Demonstrations: Synchrotron radiation, NMR, femtosecond spectroscopy, coherent Raman spectroscopy for combustion diagnostics, astro-physical applications. Laboratory work: Fourier transform spectroscopy and flame emissionApplied laser spectroscopy on atmospheric gases, Doppler-free saturation spectroscopy.

## Course design

The teaching consists of lectures/laboratory sessions/group work/written assignment. Participation in laboratory sessions and connected teaching is compulsory.

## Assessment

Written examination at the end of the course. Students who do not pass the regular exam are offered a new possibility shortly after the regular exam.

*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, approved examination is required/approved laboratory reports/passed written assignment and participation in all compulsory parts.

## Entry requirements

For admission to the course is required:

English B

FYSA31 or the equivalent.

## Subcourses in FYST14, Physics: Atomic and Molecular Spectroscopy

Applies from H16

0711 Exam, 6,0 hp
Grading scale: Fail, Pass, Pass with distinction
0712 Laboratory Exercises, 1,5 hp
Grading scale: Fail, Pass

Applies from H07

0701 Atomic and Molecular Spectroscopy, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction