Faculty of Science

FYSU36, Physics: Molecular Physics, 7.5 credits

Fysik: Molekylfysik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-10-31 to be valid from 2019-10-31, autumn semester 2019.

General Information

The course is offered as a commissioned education.

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

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 aims to both that theoretical and practical parts as treat basic molecular theory and molecular spectroscopy.

Knowledge and understanding

On completion of the course, the student should:

- be able to describe how a molecule interacts with electromagnetic radiation via electric dipole transitions and Raman scattering processes.
- be able to describe how temperature and molecular symmetry can affect this interaction.
- be able to explain the principles of interaction with rotational, vibrational, and electronic states for some of the simple molecules.
- be able to describe and compare advantages and disadvantages with different technologies for different wavelength regions from microwaves to the X-ray

Competence and skills

On completion of the course, the student should:

- be able to analyse molecular spectra for diatomic and polyatomic molecules.
- be able to calculate different parameters such as temperature and moment of inertia from a spectrum of a diatomic molecule.
- be able to decide the symmetry characteristics of diatomic and some simple polyatomic molecules based on analysis of different spectra for IR and Raman scattering.
- be able to write laboratory reports with a thorough analysis of measurement data.
- be able to orally and in writing summarise a written project assignment. The written assignment can be of investigating nature on how molecular spectroscopy can be applied within science, industry or society.
- be able to solve assignments that require use of information from other sources than the course material e.g. via Internet and databases.

Judgement and approach

On completion of the course, the student should:

- be able to extract the essential information in an advanced English textbook.

Course content

- Introduction
- Repetition of atomic structure
- Basic molecular orbital theory (linear combination of atomic orbitals, binding and anti-bonding orbitals, hybridisation of orbitals, covalent bindings, basic molecular properties that can be explained with these theories),
- Born-Oppenheimer approximation
- Spectral transitions
- Selection rules and procedures
- Franck-Condon principle and transition strengths
- Term notations
- Microwave spectroscopy Molecular rotation of simple and polyatomic molecules, technologies for rotational spectroscopy
- Infrared spectroscopy: Vibrations of simple and polyatomic molecules, infrared techniques
- Theory of Raman spectroscopy
- Electron spectroscopy Theory and technologies.

Laboratory session: Computer simulation of simple molecular spectra and adaptation to experimental measurement data
Demonstrations: Emission spectroscopy, Laser-induced fluorescence.

Course design

The teaching consists of lectures, laboratory session and written assignments. Participation in laboratory session and written assignment are compulsory.

Assessment

Examination takes place in writing at the end of the course. To pass in the course, the student must achieve certain credits of written examination laboratory session, written assignments.

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.
The grade is received through examination. Well implemented written assignments give additional credits on examination.

Entry requirements

For admission to the course, 90 credits natural sciences are required in which knowledge equivalent to FYSA31 Physics 3, Modern physics, 30 credits should be included and English B.

Subcourses in FYSU36, Physics: Molecular Physics

Applies from H19

1901 Molecular Physics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction