UNIVERSITY OF GOTHENBURG

DEPARTMENT OF PHYSICS

FYM300 Spectroscopy, 7.5 credits

Spektroskopi, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2019-03-11 and was last revised on 2023-05-08 to be valid from 2024-01-15, spring semester of 2024.

Field of education: Science 100%
Department: Department of Physics

Position in the educational system

The course is elective in the master program in physics.

The course can be part of the following programmes: 1) Complex Adaptive Systems, Master's Programme (N2CAS) and 2) Physics, Master's Programme (N2PHY)

Main field of studies	*Specialization*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

A Bachelor's degree in physics or the equivalent, including optics and electromagnetism.

Applicants must prove their knowledge of English: English 6/English B from Swedish Upper Secondary School or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

Learning outcomes

To provide a broad introduction to the field of modern spectroscopy with particular emphasis on modern experimental techniques and theoretical background.

To familiarize students with central unifying concepts and experimental as well as theoretical methods needed for the understanding of modern spectroscopy.

To highlight the importance of symbiosis between experimental and theoretical approaches in the spectroscopy disciplines.

To introduce the key physical concepts of atomic and molecular spectroscopy and microscopy, as well as give an overview of their applications.

On successful completion of the course the student will be able to:

explain the basic concepts to describe phenomena that are responsible for the importance of spectroscopy in modern science and technology.
name and explain some of the most important experimental and theoretical methods commonly used.
apply theoretical reasoning to account for experimental observations, and to build simple physical models for properties and processes occurring in atoms and molecules upon interaction with electromagnetic radiation.
explain the key phenomena for the interaction of electrons with the matter.

Course content

Electron and photoelectron spectroscopies, atoms (hydrogen atom) and small molecules. Classification of electronic states.
The concept of dielectric function. Lorentz model of optical permittivity. Transmission, Reflection, Absorption and Scattering spectroscopy.
Raman spectroscopy and modern methods, CARS, hyper-Raman, stimulated Raman, Fourier Transform Raman, polarization methods, etc. (including surface-enhanced Raman).
Infrared and far-infrared absorption spectroscopy: vibrations and rotations (FTIR microscope, IR selection rules, symmetry).
Fluorescence spectroscopy and microscopy (including advanced techniques, such as single molecules, FCS, FRET, FLIM, antibunching, super-resolution, etc.).
Cathodoluminescence and electron energy loss spectroscopy (EELS).

Form of teaching

The main course content will be given during the lectures.
In addition to the lectures, there will be two COMPULSORY laboratory works, devoted to optical spectroscopy and electron spectroscopy correspondingly. The optical part will include Raman and FTIR microscopy and spectroscopy, while the electron spectroscopy part will include cathodoluminescence and EELS.
The course also included optional homeworks, which will give BONUS points at the exam.

Language of instruction: English

Assessment

A written exam at the end of the course.
Getting a "PASS" at the compulsory labs.
BONUS points for the homeworks.

If a student, who has failed the same examined element on two occasions, wishes to change examiner before the next examination session, such a request is to be submitted to the department in writing and granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In the event that a course has ceased or undergone major changes, students are to be guaranteed at least three examination sessions (including the ordinary examination session) over a period of at least one year, though at most two years after the course has ceased/been changed. The same applies to work experience and VFU, although this is restricted to just one additional examination session.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.