SK2800 Laser Spectroscopy 8.0 credits

Laserspektroskopi

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

Establishment

Course syllabus for SK2800 valid from Autumn 2018

Grading scale

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

Education cycle

Second cycle

Main field of study

Physics, Engineering Physics

Specific prerequisites

Modern Physics, or Molecular Structure for K2 and BIO2, or Quantum Chemistry and Spectroscopy for K4.

Language of instruction

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

Intended learning outcomes

After the course, the student should:

- have knowledge about the quantum physical description of atoms and molecules and be able to relate these to their spectral properties.
- be able to explain and describe the transitions between different electronic states and do quantum mechanical calculations on the same.
- be able to solve technical problems related to the frequency condition and the modal structure of lasers, and be able to read and evaluate the energy level diagram for lasers.
- be able to describe the common spectroscopic methods.
- have practical experience of experimental laser and spectroscopic measurement techniques and instrumentation.
- be able to use advanced spectrometers within the field of laser induced fluorescence, laser Raman spectroscopy, and to analyse fluorescence spectra.
- have searched the scientific literature and acquired knowledge about a contemporary spectroscopic method and presented the findings in a short seminar for the class.

Course contents

The course starts with a short introduction to the laser and its physical properties. We then discuss light-matter interaction using a quantum mechanical description, starting from the basics of atoms and molecules. We study a number of modern spectroscopic techniques and their use in biological and chemical physics, medicine, and environmental science. Focus is on practical examples from society and advanced techniques used in the research laboratory. The course includes laborations where we apply the measurement techniques and the data analysis studied.

The main topics of the course are: Structure and dynamics of molecules. The construction and function of lasers. Interaction between light and matter. Laser types: narrow band and tunable, continuous wave and pulsed lasers, ultra-fast lasers and their physics. Laser applications in molecular physics and chemical physics: high resolution spectroscopy, short lived molecules (free radicals and ions), laser induced breakdwn spectroscopy (LIBS) femtosecond chemistry and spectroscopy, the use of the laser in medicine and for diagnostic purposes.

Course literature

Laser Chemistry: Spectroscopy, Dynamics & Applications

Helmut H. Telle, Angel González Ureña, Robert J. Donovan, University of Edinburgh, Scotland

ISBN: 978-0-471-48571-1 2007

Distributed material

Examination

- TEN1 - Examination, 6.0 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 2.0 credits, grading scale: P, 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.

Other requirements for final grade

One written exam (TEN1; 6 university credits). To get the final mark the laboratory experiments have to be completed and approved (LAB1; 2 university credits).

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.