Faculty of Science

KEMM29, Chemistry: Molecular Spectroscopy - Methods and Applications, 15 credits

Kemi: Molekylspektroskopi - metoder och tillämpningar, 15 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2018-11-23 to be valid from 2018-11-23, autumn semester 2019.

General Information

The course is an elective second-cycle component of a degree of Master of Science (120 credits) in Chemistry.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Organizing Molecular Matter	A1F, Second cycle, has second-cycle course/s as entry requirements
Chemistry	A1F, Second cycle, has second-cycle course/s as entry requirements

Learning outcomes

The course builds on previous studies in spectroscopy. The aim is to enable students to acquire specialised understanding of how light interacts with molecules and materials. Different methods of optical spectroscopy and their use to examine chemical and physical properties are addressed at an advanced level.

Knowledge and understanding

On completion of the course, the students shall be able to

- explain the electronic processes that can be excited by light
- describe how scattered and emitted light from a sample can be determined and measured

- explain the basic principles and properties of a laser and how it can be used in an optical experiment
- provide an advanced account of how experimental spectroscopic data are interpreted in terms of the properties of molecules and molecular systems
- describe the physical principles of an elementary photochemical reaction

Competence and skills

On completion of the course, the students shall be able to

- discuss different spectroscopic methods and compare their advantages and disadvantages
- perform simple calculations based on spectroscopic data in order to obtain molecular properties
- use optical spectroscopy to plan and perform experiments and calculations
- propose appropriate spectroscopic methods to determine specific molecular properties
- write laboratory reports in the field of optical spectroscopy

Judgement and approach

On completion of the course, the students shall be able to

- assess the uncertainties and error limits of spectroscopic data and evaluate them
- critically discuss and evaluate results from measurements performed with optical spectroscopy

Course content

Lectures, 7.5 credits:

- basic principles of interaction between light and molecules, and the formation of excited states
- the time evolution of excited states in intra- and intermolecular energy and electron transitions and their role in photochemical reactions
- description of different sources of light (e.g. lasers) and light detectors of relevance to spectroscopy
- detailed descriptions of different optical methods such as absorption and fluorescence spectroscopy and time-resolved laser spectroscopy
- introduction to fluorescence microscopy and detection of individual molecules
- introduction to X-ray spectroscopy for measurement of molecular structure and chemical bonding

Laboratory sessions, calculation exercises and seminars, 7.5 credits:

- laboratory sessions providing practical experience of spectroscopic methods and measurements
- exercises and seminars consisting of calculation exercises and discussions of subjects addressed in lectures

Course design

The teaching consists of lectures, calculation exercises, seminars and laboratory sessions. Compulsory participation is required in computer exercises, laboratory sessions and associated elements.

Assessment

The assessment is based on a written exam at the end of the course and compulsory components throughout the course.

Students who fail an assessment will be offered another opportunity for assessment soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

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.
For a grade of Pass on the whole course, the student must have passed the final exam and the compulsory components.

The grades awarded for the exam are Fail, Pass and Pass with Distinction. The grades awarded for the calculation exercises, seminars and laboratory sessions are Fail and Pass.

The final grade is determined by the aggregated result of the final written exam and the calculation exercises, seminars and laboratory reports.

Entry requirements

To be admitted to the course, students must meet the general entry requirements for higher education and requirements for English proficiency corresponding to English 6 from Swedish upper secondary school, and have passed 90 credits in science courses including courses equivalent to:

- KEMA20 General Chemistry 15 credits, or KEMA10 General Chemistry 7.5 credits and KEMA12 Inorganic Chemistry - Basic Course 7.5 credits, KEMA01 Organic Chemistry - Basic Course 7.5 credits and KEMA03 Biochemistry - Basic Course 7.5 credits
- KEMB09 Physical Chemistry - Basic Course 15 credits
- KEMM30 Molecular Driving Forces and Chemical Bonding 15 credits
- MATA02 Mathematics for Scientists 15 credits, or the equivalent

Knowledge equivalent to KEMB29 Spectroscopy and Dynamics 7.5 credits is recommended.

The admission requirements are also satisfied by students who meet the general entry requirements for higher education and requirements for English proficiency corresponding to English 6 from Swedish upper secondary school, and have passed courses equivalent to:

- 75 credits in physics including FYSC11 Atomic and Molecular Physics 7.5 credits and FYSC13 Solid State Physics 7.5 credits and

- 30 credits in mathematics

Students who have obtained the equivalent knowledge by other means may also be admitted to the course.

Further information

The course may not be included in a degree together with KEMM19 Optical Methods in Molecular Spectroscopy 15 credits.

Subcourses in KEMM29, Chemistry: Molecular Spectroscopy - Methods and Applications

Applies from H19

1901 Molecular Spectroscopy – Methods and Applications, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction
1902 Molecular Spectroscopy – Methods and Appl., Comp. Elements, 7,5 hp
Grading scale: Fail, Pass