Chemistry

/Kemi/

The governing rules common for all PhD Studies at Linköping University's Institute of Technology can be found in the faculty's *Study Handbook for PhD Studies*. Some overall rules can also be found in Linköping University's local rules and regulations as well as in the Higher Education Act and the Higher Education Ordinance.

The research area Chemistry includes four specialisations:

- **Chemistry with specialisation in Physical Chemistry**/ Kemi med inriktning mot fysikalisk kemi/ SCB codes: 10402, 10407/
- **Chemistry with specialisation in Material Chemistry**/ Kemi med inriktning mot materialkemi/ SCB codes: 10404, 10403, 10406/
- **Chemistry with specialisation in Organic Chemistry**/ Kemi med inriktning mot organisk kemi/ SCB codes: 10405, 10401/
- **Chemistry with specialisation in Protein Science**/ Kemi med inriktning mot proteinvetenskap/ SCB codes: 10601, 10602, 10603/

General description of the research area

The education at the research level in Chemistry shall give the student the ability to independently conduct research work, as well as provide in-depth knowledge and skills in the field. The research's applications focus on issues in biology, physics, materials science and medicine. Chemistry is, as science, interdisciplinary, which is also reflected in chemical research in subjects. A significant development in graduate education is the focus on chemical biology. Chemical biology allows to carry out chemical experiments directly in living cells. Within this field, several courses focus on protein science and organic chemistry with cell biological expertise. Within the physical and materials-chemical research areas there is a large and active collaboration with research and graduate studies in materials science and theoretical physics and chemistry.

Within the field of physical chemistry, research in computational chemistry, chemical bonding, quantum chemistry, molecular simulations and statistical thermodynamics is related to molecular spectroscopy, photochemistry, structural chemistry and especially nanocemiology. The research is of cross-cutting nature and often happens in collaboration with several other subjects at LiU, such as inorganic chemistry, surface chemistry and several material physics areas, as well as groups at other universities both nationally and internationally.

Within the field of material chemistry, research and studies mainly concern material chemical synthesis of classical inorganic materials primarily through synthesis of thin films with chemical vapor deposition (CVD) and synthesis of nanostructured materials with wet chemical methods. The research focuses on developing synthesis methods in order to control material properties. Most of this research takes place in close collaboration with Materials Science. Research is also done in organic materials designed from a molecular perspective for applications in biomaterials, regenerative medicine, electronics, photonics and biosensors.

Within the field of organic chemistry, research areas include organic synthesis, drug chemistry and biochemical chemistry for applications in chemical biology. In addition, methods of analytical carbohydrate chemistry and forensic chemistry are developed.

Within the field of protein science, research and studies are underway on a number of aspects of protein chemistry, protein structure, function and dynamics, as well as identification and design of enzymes. Biophysical, biochemical, and structural biological methods are used. Method development is conducted specifically in the areas of NMR spectroscopy, fluorescence spectroscopy and data analysis. Within the focus, protein folding, protein interactions, transcriptional activation, protein aggregation and related diseases, chaperone function, protein evolution and metabolism are studied.

Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*.

Specific eligibility requirements

Admission to PhD Studies in the research area of Chemistry requires completion of courses of at least 60 ECTS at the master level in a relevant research area. These 60 ECTS should include an independent project (degree project) of at least 30 ECTS in a field relevant to the subject of PhD studies.

Degree

PhD studies in Chemistry leads to a Degree of Doctor or a Degree of Licentiate. The latter degree can also serve as a stage in the PhD studies. The Degree of Licentiate comprises 120 ECTS, of which courses correspond to 30 ECTS and the licentiate thesis corresponds to 90 ECTS. The Degree of Doctor comprises 240 ECTS, of which courses correspond to 60 ECTS and the doctoral thesis corresponds to 180 ECTS.

Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook*'s appendix A).

PhD studies in Chemistry will equip the PhD student with the knowledge and skills to fulfill all the degree outcomes. Exactly how the different degree outcomes are treated and tested is indicated more specifically in each PhD student's individual study plan. General examples are given below regarding how the degree outcomes could be treated and tested.

The PhD studies will endow the PhD student with a broad knowledge and understanding of his/her area of research, especially through work with the various research projects and study of basic and wide-ranging courses (see examples below in the section on Courses). PhD students who are admitted to the research area of Chemistry can also be members in a graduate school (e.g. Forum Scientium or Agora Materiae).

The PhD student will acquire a deep knowledge and understanding of his/her research area, and in particular within his/her research specialisation, through, among other things, work with research projects, participation in the research group's seminars, and active participation in in-depth courses relevant to the research projects.

The PhD student will develop familiarity with scientific methodology through his/her own research and by completing a mandatory course in research methodology.

Below are some examples of how PhD students in the research area of Chemistry acquire skills and competencies:

- By independently planning and carrying out experimental research
- By participating in the research group's seminars. This includes reporting the attained results, presenting plans for continued work and holding critical discussions of the research work at least once a year.
- By participating in relevant national and international conferences and presenting at such fora research results, orally and/or as poster
- By participating in so-called non-core subject courses such as presentation techniques, leadership, management, patent and intellectual property law, methodology and pedagogy

The PhD student in Chemistry will develop judgement and approach through, for example:

- Attending a mandatory course in research ethics
- Participating in seminars and conferences within his/her area of research
- Working together with his/her research group and with collaboration partners

Thesis

The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*. In a compilation thesis, the greater part of the included works should be accepted for publication or published.

Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year.

Supervision

General rules governing supervision of PhD studies can be found in Chapter 4 of the *Study Handbook for PhD Studies* and in the *Policy for the Supervision of PhD Studies.*
At the beginning of PhD studies, a main supervisor will be appointed for each PhD student. Moreover, one or more co-supervisors will be appointed. The supervisors' roll is to guide the student during the period of study regarding, among other things, course selection and selection of research projects. The student and the supervisors should meet regularly to discuss and consult on the progress of the research work.

Courses

For all the course requirements, please see the section on Degree. At least 38 ECTS in the research area's core courses (including any accredited courses) are required for a Degree of Doctor. At least 15

ECTS in the research area's core courses (including any accredited components) are required for a Degree of Licentiate.

Faculty course requirements

Scientific theory, methodology and ethics

All PhD students admitted as of 1 January 2010 should complete mandatory courses as decided by the faculty in methodology and ethics, or be deemed to have equivalent competencies, in order to receive a degree.

Pedagogic studies

All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

Courses within the core of the research area

Examples of the research area's core courses within the specialisation Physical Chemistry:
Physical Chemistry Thermodynamics, Physical Organic Chemistry, Physical Chemistry Spectroscopy, Quantum Mechanics, Calculation Chemistry, Calculation Physics, Chemical Bonding, Numerical Calculation Methods, Electrochemistry, Programming, Surface and Colloid Chemistry, Solid State Physics, Quantum Chemistry, Surface Physics, Materials Chemistry, Nanophysics, Nanochemistry, Statistical Thermodynamics, Advanced Physical Chemistry.

Examples of the research area's core courses within the specialisation Material Chemistry:
Advanced inorganic chemistry, advanced material chemistry, structural chemistry, periodic system trends, chemical vapor deposition, vacuum technology, thin film physics, solid state physics, group theory, electron microscopy, material optics, diffusion, dislocations, fungal microscopy, thin film XRD, polymer chemistry, organic electronics.

Examples of the research area's core courses within the specialisation Organic Chemistry:
Advanced Organic Chemistry, Physical Organic Chemistry, Advanced Organic Synthesis, NMR, Protein Chemistry, Pharmaceutical Chemistry, Pharmacology, Nanochemistry, Natural Product Chemistry, Mass Spectrometry, Carbohydrate Chemistry, Separation Techniques.

Examples of the research area's core courses within the specialisation Protein Science:
Advanced Biochemistry, Protein Chemistry, Protein Week, Biofysical Chemistry, Fluorescence Spectroscopy, NMR Spectroscopy, Protein Structure, Function and Dynamics, Bioinformatics, Biomolecular Disease Processes, Natural Product Chemistry.

Courses within none-core field

Besides courses within the research area, the PhD student can also select courses in non-core fields (e.g. presentation techniques, leadership, intellectual property law, project management, entrepreneurship, media training, scientific publication, etc.).

Other courses and activities

Courses taken at other departments or universities, such as summer schools, may be included, just as self-study within special fields. Likewise, special activities such as active participation in symposia, seminars, conferences and contract research, etc. may be reported and included as components of the PhD studies.

Transitional provisions

Changes to the general study syllabus do not apply to those who have already been admitted to PhD studies in the research area. A change to the new general study syllabus may however be approved if both the main supervisor and the PhD student agree. In such a case, this should be documented in the individual study plan.