Translation of Subject Curriculum (Study Plan) for Third-cycle (PhD) Education

Chemistry with specialisation in Molecular Biomimetics

Swedish title: Kemi med inriktning mot molekylär biomimetik

TNKEMI11

Swedish curriculum adopted by the Board of the Faculty of Science and Technology (Third-cycle Educational Board) on 2018-07-02, revision on 2019-06-11. Translation approved on 2019-06-11.

The Study Plan for third-cycle studies consists of three parts: a general part, this subject specific study plan, and each doctoral student's individual study plan.

Objective

Based on the general training within the scientific discipline, the education at the graduate level shall provide additional competences within Chemistry and result in deep knowledge within Molecular Biomimetics.

Through training at the graduate level shall the doctoral student, via participation in advanced courses and by performing his/her own research under supervision, obtain deep theoretical and practical competence in methods relevant for Chemistry and Molecular Biomimetics.

Those that have obtained a degree in Chemistry with specialization in Molecular Biomimetics shall be well prepared for performing research in a critical and independent manner. In addition to the academic environment, they are expected to be able to perform research and development projects in, for example, industry, management and companies. Furthermore, the education shall enable the doctoral student to actively participate in scientific discussions.

The doctoral student must be able to present her/his goals and results in oral and written form for different audiences in English, and in case
of Swedish-speaking doctoral students, also in Swedish. Through active participation in group meetings, seminars and conferences, the doctoral student must also be able to acquire and critically discuss new research topics.

Those obtaining a licenciate degree in Chemistry with specialisation in Molecular Biomimetics must have experience in independent research work and must have reached the subject specific and methodological competence in the selected specialization that allows them to critically evaluate the scientific development in this research field.

Subject description
Research in Molecular Biomimetics is interdisciplinary and lies at the interface between biology, physics and chemistry. Our strategy is to connect fundamental studies with application-oriented research to facilitate innovations that promote the transition to a sustainable society.

The focus of Molecular Biomimetics lies in understanding and adapting/mimicking biological reactions that convert solar energy into fuels or high-value products. Specific examples of our research topics include:

- Electron and proton transfer in biological systems.
- Energy conversion in natural photosynthesis.
- Mechanistic studies of hydrogenases and nitrogenases.
- Enzyme design and production of artificial enzymes in vitro and in vivo.
- Synthesis and characterization of molecular and material-based catalysts for CO₂ and N₂ reduction, H₂-formation/oxidation, and water oxidation.
- Assembly and testing of devices for solar or electrical energy storage in fuels.

We employ and develop a number of techniques, for example within the areas of structural analysis, spectroscopy, mass spectrometry and electrochemistry.
Eligibility

Basic Eligibility
The basic eligibility for third-cycle studies is described in the general part of the study plan.

Special Eligibility
A person has special eligibility for a third level program in Chemistry with specialization in Molecular Biomimetics if she/he has passed examinations in courses in chemistry, biology or physics, or in courses of other areas of relevance for the discipline, totalling a minimum of 60 higher education credits at the advanced level. The candidate must have acquired through such courses significant knowledge in the theories relevant for the research area. A Master thesis in a relevant specialisation must also have been completed. Comparable knowledge may have also been obtained in a different way, inside or outside of Sweden.

Since the research in Molecular Biomimetics is performed within an international environment, a very good command of English, both written and spoken, is a requirement for this education.

For specific research projects additional competences and courses may be required.

Admission
Applicants for third-cycle studies in Chemistry with specialisation in Molecular Biomimetics must submit an application to the Head of the Department of Chemistry - Ångström. Admission to doctoral studies takes place normally several times per year.

Upon admission to postgraduate education, the Swedish title of the degree is to be specified in the application. According to decision (TEKNAT 2012/215), postgraduate education in Chemistry with specialisation in Molecular Biomimetics shall lead to a filosofie doktorsexamen. The English rendering will be a licentiate/doctorate degree of philosophy.

At the time of admission, the department must provide a financial assistance plan demonstrating sufficient support to cover the maintenance of the applicant as well as her/his research.
Program structure

At the time of admission, each doctoral student, together with her/his supervisor and in consultation with the professor in charge of third-cycle studies, draw up an individual study plan. The plan is to be approved by the Head of the Department (by delegation of the Faculty Board) at the time of admission.

The individual study plan shall be annually reviewed jointly by the doctoral student and her/his supervisor, and supplemented with a summary of the achieved results and the plans for the coming year. Significant changes, as well as any disagreement on the individual study plan, shall be reported to the Head of the Department or, if deemed necessary, to the Third-cycle Educational Board.

Courses

The third-cycle studies may include different kinds of courses, such as lectures, literature studies, practical training, field studies, etc. The courses are intended to provide a wider insight into the subject as a complement to the specialist competence acquired during research. The courses included in the individual study plan may be selected among courses and summer schools both inside and outside of Sweden, as long as they do not overlap with the admission requirements.

The following courses should normally be included in the studies (suggested year and credits):
- Literature studies related to the doctoral project should be conducted and summarized in a mini-review that should be submitted to a scientific journal (year 1; 5-10 higher education credits).
- A current course book should be selected and read that widens the competence of the doctoral student. This selection should be agreed between the doctoral student, the supervisor and the professor responsible for the third level studies. The new competences should be demonstrated through an oral examination (year 2; 5-10 higher education credits).
- A research proposal should be written (year 3; 5-10 higher education credits).
- At least one advanced course within theoretical, biophysical, biochemical, synthetic or microbiological methods that enhances or broadens the skills of the doctoral student (year 1-3; 5-15 higher education credits).
- At least two own presentations (halftime and final; together 2 higher education credits).

The courses above should total at least 30 higher education credits for a doctoral degree, or at least 15 higher education credits for a licentiate degree.

Recommended courses:
- Introduction to doctoral studies.
- Scientific writing and/or presentation.

A course in research ethics (at least 2 higher education credits) is mandatory for the licentiate and doctoral degree. For doctoral students who teach at the basic or advanced level, pedagogical training in higher education is also mandatory.

Higher education credits obtained during studies at the basic or advanced levels can be credited. This requires an agreement between the doctoral student, the supervisor and the professor in charge of the third level program. The guideline for the number of credits is the relevance of the course content for the specific doctoral education.

Requirements for doctoral degree
The requirements for the doctoral degree consist of passed examinations in the courses included in the approved individual study plan of each doctoral student, as well as a passed public defence of the degree project. The course studies leading to the award of a doctoral degree comprises 240 higher education credits (four years of full-time studies), of which the doctoral thesis comprises a minimum of 120 higher education credits and the coursework part a minimum of 40 higher education credits.

Requirements for licentiate degree
A doctoral student who has acquired at least 120 higher education credits (two years of full-time studies) is eligible for a licentiate degree. The requirements consist of passing the examinations included in the program stage and receiving a passing grade on an academic paper of at least 60 higher education credits. Coursework totalling a minimum of 20 higher education credits must be included.

Other
The doctoral education shall not only prepare the doctoral student for a research carrier, but also allow obtaining pedagogical competences.
Doctoral students are thus expected to contribute to departmental activities related to education and administration.

The interaction with society and companies (‘samverkan’) plays an increasingly important role and is an integral part of the doctoral education. Doctoral students are thus expected to actively participate in at least one outreach event during their doctoral education.

Additional information can be obtained by the program responsible professor and the professor responsible for the third cycle studies in Chemistry with specialisation in Molecular Biomimetics.

More information about our research can be found at the department homepage: www.kemi.uu.se.