

Faculty of Technology and Science

**Curriculum for Doctoral Studies in Chemistry
at Karlstad University**

Approved by the Faculty Board of Technology and Science on 4 September 2008.

Curriculum Approval

The curriculum was approved by the Faculty Board of Technology and Science on 4 September 2008. The PhD programme is offered to the extent permitted by available funding. General stipulations for PhD programmes are provided in the *Higher Education Act* and in the *Higher Education Ordinance*.

1. General Information

Doctoral studies in chemistry at Karlstad University are offered in four areas: analytical chemistry, biochemistry, physical chemistry and chemistry education. The discipline chemistry centres on basic and applied processes at the molecular level, aiming at producing new knowledge, developing new processes and methods and providing support to the technological and societal development in many areas.

At Karlstad University chemistry research is basic and applied with relevance to chemistry. Research is primarily experimental at molecular level, and pursued in conjunction and exchange with others and in line with the technological development in the area in question.

In analytical chemistry, research on separation methods is carried out with application to the area of bio-analytical chemistry as well as to that of metals. Research in biochemistry has a focus on the macro molecular function and structure of biological processes with molecular genetic background and biotechnological applications. Physical chemistry centres on surface and colloid chemistry as well as nanomaterials. Chemistry education research is carried out in conjunction with disciplinary and education research. It deals with teacher and student issues of perception and professional development.

The objectives of doctoral studies in chemistry are that the students acquire the advanced knowledge and skills required for applying modern experimental methods and model systems in their area and that they develop abilities to pursue a science project independently and evaluate and communicate results to academic as well as non-academic communities.

In accordance with Karlstad University's equal opportunities policy, gender issues are addressed throughout the programme. Doctoral students are also introduced to multi-disciplinary approaches and involved in interdisciplinary experiences.

2. Aims and Objectives

The general objectives of licentiate or doctoral studies in terms of knowledge and understanding, skills and abilities, and judgement and approach are specified as follows in the *Higher Education Ordinance, attachment 2, SFS 2006:1053*):

Knowledge and understanding

For a degree of Licentiate research students must

- demonstrate knowledge and understanding in the field of research, including current specialist knowledge in a defined part of the field and a deeper knowledge of scientific methods in general and of methods in the specific field of research in particular.

For a degree of Doctor research students must

- demonstrate broad knowledge in and systematic understanding of the field of research, together with deep and up-to-date specialist knowledge in a defined part of the field of research; and
- demonstrate familiarity with scholarly methods in general and with methods in the specific field of research in particular.

Skills and abilities

For a degree of Licentiate research students must

- demonstrate an ability to identify and formulate issues, critically, independently and creatively, and proceeding with scientific precision; to plan a limited research project and other advanced tasks and to carry them out using appropriate methods within specified time limits, so as to contribute to the development of knowledge; and to evaluate this work;
- demonstrate an ability to clearly present and discuss research and research results in dialogue with the scholarly community and society in general, orally and in writing, in both national and international contexts; and
- demonstrate the skills required to independently participate in research and development work and to work independently in other advanced contexts.

For a degree of Doctor research students must

- demonstrate an ability to engage in scholarly analysis and synthesis and in independent, critical examination and assessment of new and complex phenomena, issues and situations;
- demonstrate an ability to identify and formulate issues, critically, independently and creatively, and proceeding with scientific precision, and to plan and, using appropriate methods, conduct research and other advanced tasks within specified time limits, and to scrutinise and evaluate such work;
- demonstrate, in a dissertation, their ability to make a substantial contribution to the development of knowledge by their own research;
- demonstrate an ability to present and discuss research and research results with authority, in dialogue with the scholarly community and society in general, orally and in writing, in both national and international contexts;
- demonstrate an ability to identify their need of further knowledge; and
- demonstrate a potential to contribute to the development of society and support other people's learning, both in the field of research and education and in other advanced professional contexts.

Judgement and approach

For a degree of Licentiate research students must

- demonstrate an ability to make ethical assessments in their own research;
- demonstrate insight into the possibilities and limitations of science, its role in society and people's responsibility for how it is used; and
- demonstrate an ability to identify their need of further knowledge and to take responsibility for developing their knowledge.

For a degree of Doctor research students must

- demonstrate intellectual independence and scholarly integrity and an ability to make ethical assessments relating to research; and
- demonstrate deeper insight into the potential and limitations of scholarship, its role in society and people's responsibility for how it is used.

Licentiate dissertation/doctoral dissertation

For a degree of Licentiate the research students must have received a pass grade on a scholarly dissertation of at least 60 ECTS credits.

For a degree of Doctor the research students must have received a pass grade on a doctoral dissertation of at least 120 ECTS credits.

Subject Specific Objectives

The aim of doctoral studies in chemistry is that the students deepen their experimental and theoretical knowledge in the field and develop their ability to lead projects independently and evaluate and disseminate research results. They should also develop their ability to acquire and apply new methods on the basis of current problems and their ethical awareness. Finally, students should develop their professional capacity for work in and out of the academia and their ability to pursue research independently.

3. Admission Requirements

Applicants to doctoral studies must meet the general admission requirements as well as the specific admission requirements and be judged to have the ability otherwise required to pursue the programme successfully (*Higher Education Ordinance, Ch.6*).

3.1 General eligibility

A person who has earned a Master's degree of at least 240 ECTS credits of which at least 60 ECTS cr are studies at Master's level, or who in some other way in the country or abroad has acquired largely equivalent knowledge has general eligibility for admission. If there are special reasons for doing so, the faculty board may grant an individual applicant exemption from the general eligibility (*Higher Education Ordinance, Ch.6*).

3.2a. Special eligibility for admission to doctoral studies in analytical chemistry, biochemistry or physical chemistry

A person who has a Master's degree with completed courses in chemistry totalling at least 120 ECTS cr, of which 30 ECTS cr are earned at Master-level and include a degree project of relevance to the proposed research area of at least 15 ECTS cr, or who in some other way in the country or abroad has acquired largely equivalent knowledge, has special eligibility for admission to doctoral studies in analytical chemistry, biochemistry or physical chemistry. It is recommended that the Master-level degree project is at least 30 ECTS credits.

3.2b. Special eligibility for admission to doctoral studies in chemistry education

A person who has a Master's degree in a natural science main field of study of at least 90 ECTS cr including a degree project of at least 15 ECTS cr of relevance to the proposed field, or has a teaching degree of an earlier ordinance and at least two years of experience of teaching chemistry has special eligibility for admission to doctoral studies in chemistry education.

3.3. Transitional Provisions

Students who met the general admission requirements for admission to doctoral studies before 1 July 2007 shall be considered generally eligible for admission to the doctoral level until 30 June 2015 (SFS 2006:1053).

4. Admission Procedure

Applications for admission to doctoral studies are processed in accordance with the procedures prescribed by the Board of Karlstad University.

5. Selection

Candidates will be selected on the basis of their assessed capacity to successfully complete a programme at the doctoral level. In the ranking and selection of the candidates, special attention will be paid to previous studies, especially to the quality of independently documented research or development projects completed at Master's level. Special consideration will be given to the candidates' subject knowledge in the proposed area and to their documented methodological knowledge. The highest ranking candidates will be interviewed. Special attention will also be given to the research proposal and the supervision capacity in the proposed area.

6. Content and Outline

The doctoral programme can lead to a doctoral or licentiate degree. The doctoral degree requires four years of study, the equivalent of 240 ECTS credits, and the licentiate degree two years or 120 ECTS credits. The studies include course work as well as independent thesis work. To earn a doctoral degree in physics, the candidate must complete 60 ECTS credits of course work and a dissertation of 150 ECTS cr. To earn a licentiate degree, the candidate is required to complete 30 ECTS credits of course work and a dissertation of 75 ECTS cr.

6.1 Courses

Mandatory courses for all doctoral students at Karlstad University must be included in the programme to the extent required by local regulations.

General mandatory course

For the **Licentiate** degree:

The History and Philosophy of Science, 7.5 ECTS credits

For the **Doctor's** degree:

The History and Philosophy of Science, 7.5 ECTS credits, and
Communicating Science, 4.5 ECTS credits

The *Higher Education Ordinance* (Ch. 6 § 6) allows for the possibility of transferring credits for completed courses at another university provided that there is no substantial difference.

Subject Specific Courses

Recommended dissertation proposal

The proposal is an introduction to the dissertation, written in the first year of the programme. The student summarizes and analyzes literature associated with the dissertation topic, thus gaining an overview of the research field and developing critical abilities. The proposal should be in English and presented at a seminar. Approved proposal and presentation will count as 5 ECTS credit coursework.

Problem formulation

Doctoral students are recommended to formulate a research programme for an imagined post-doctoral project in an area not directly related to the dissertation project. The plan should include background, research questions and methods. The estimated workload should be 3 weeks and count as 5 ECTS credit coursework.

Courses

Students choose courses in consultation with the examiner and advisor on the basis of their need for theoretical and practical specialisation. Courses offered at Karlstad University, at other universities in Sweden or abroad may be relevant and suitable. The number of credits awarded is determined by student and advisor in conjunction.

6.2 Doctoral and Licentiate Dissertations

Doctoral students are required to write a dissertation for a doctoral or a licentiate degree. Dissertations should either be a monograph or a unified collection of previously published papers in English. The latter alternative is recommended. Candidates are required to defend their licentiate dissertation at a seminar and their doctoral dissertation at a public examination. The dissertation topic is chosen in consultation with advisor and examiner. The unifying frame should be written in English just as the included subprojects.

Further information is provided by the policy documents “Doctoral Dissertation Requirements” and “Licentiate Dissertation Requirements”.

6.3 Supervision

Doctoral students are entitled to advisors in accordance with the principles stated in the current policy document at Karlstad University.

6.4 Individual Study Plan

Each doctoral student must draw up an individual study plan in conjunction with the advisors. The plan should include a realistic estimate of time for course work, thesis work and supervision as well as an introduction to the proposed research field, problem, aim, methodological and theoretical frames, and relevant ethical considerations.

The individual study plan is subject to continual revision (at least once a year).

6.5 Examination

Doctoral students are examined in accordance with the requirements of each individual course syllabus. Doctoral or licentiate dissertations are examined in accordance with the *Higher Education Ordinance* (Ch.6, §§ 40-47) and Karlstad University’s current policy document.