



## **General syllabus for third-cycle studies in Biophysical Chemistry TEKFKF05**

The syllabus was approved by the Board of the Faculty of Engineering/LTH 9 December 2011 and most recently amended 12 March 2019 (reg. no U 2019/104).

### **1. Subject description**

The subject involves research and third-cycle studies in biophysical chemistry. Methods of physics and molecular biology are used to study proteins and other biomolecules in solutions or more complex systems in order to explain biological function in terms of molecular exchange, structure and dynamics. Research in biophysical chemistry also deals with simpler model systems of relevance to the subject. The prevailing experimental technique is nuclear magnetic resonance (NMR) for which the department at LTH has unique expertise and equipment and also engages in method development.

### **2. Objective of third-cycle studies at LTH**

The Board of LTH established the following objective for third-cycle studies on 15 February 2007.

The overall objective of third-cycle studies at LTH is to contribute to social development and prosperity by meeting the needs of business and industry, academia and wider society for staff with third-cycle qualifications. LTH shall primarily provide education leading to a PhD or licentiate in the fields of LTH's professional degrees. The programmes are first and foremost intended for the education of engineers and architects. The programmes are designed to encourage personal development and the individual's unique qualities.

Third-cycle graduates from LTH shall demonstrate:

- proficiency in research theories and methods and in a critical, scientific approach
- both breadth and depth of knowledge within the subject of his or her third-cycle studies

The programmes aim to develop:

- creativity and independence with the ability to formulate advanced research issues, solve problems and plan, carry out and evaluate projects within a set time frame
- openness to change

- personal networks, both national and international
- social skills and communication skills
- teaching ability
- innovation skills, leadership and entrepreneurship

In order to enable students to achieve these skills and abilities, LTH provides:

- high-quality supervision and good conditions for study in a creative environment
- a good balance between basic and applied research, with openness to wider society
- a range of advanced third-cycle courses at both departmental and faculty level
- a good balance between courses and thesis work
- opportunities to present research findings at national and international conferences and in internationally recognised journals, or by another equivalent method which leads to wide exposure and circulation
- opportunities to spend time in international research environments for short or extended periods

### 3. Learning outcomes for third-cycle studies

The learning outcomes for third-cycle studies are given in the Higher Education Ordinance.

#### 3.1 Licentiate

##### *Knowledge and understanding*

For a Licentiate the third-cycle student shall:

- demonstrate knowledge and understanding in the field of research including current specialist knowledge in a limited area of this field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.

##### *Competence and skills*

For a Licentiate the third-cycle student shall:

- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge as well as to evaluate this work
- demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and society in general, and
- demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.

*Judgement and approach*

For a Licentiate the third-cycle student shall:

- demonstrate the ability to make assessments of ethical aspects of his or her own research
- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
- demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.

**3.2 Doctor of Philosophy***Knowledge and understanding*

For the degree of Doctor of Philosophy the third-cycle student shall:

- demonstrate broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and
- demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.

*Competence and skills*

For the degree of Doctor of Philosophy the third-cycle student shall:

- demonstrate the capacity for scholarly analysis and synthesis as well to review and assess new and complex phenomena, issues and situations autonomously and critically
- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work
- demonstrate through a thesis the ability to make a significant contribution to the formation of knowledge through his or her own research
- demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general
- demonstrate the ability to identify the need for further knowledge, and
- demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.

*Judgement and approach*

For the degree of Doctor of Philosophy the third-cycle student shall:

- demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics, and
- demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.

**4. General and specific admission requirements**

A person meets the general admission requirements for third-cycle courses and study programmes if he or she:

1. has been awarded a second-cycle qualification

2. has satisfied the requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second cycle, or
3. has acquired substantially equivalent knowledge in some other way in Sweden or abroad.

The higher education institution may permit an exemption from the general entry requirements for an individual applicant, if there are special grounds. Ordinance (2010:1064).

A person meets the specific admission requirements if he or she has

- a MSc in Engineering, a one-year Master's degree or other comparable degree with significant components of mathematics, molecular sciences and life sciences. Depending on the student's research project, second-cycle courses in physical chemistry, biophysical chemistry, protein science and/or molecular spectroscopy may be required.

Finally, the student must be judged to have the potential to complete the programme.

Exemptions from the admission requirements may be granted by the Board of LTH.

## 5. Selection

Selection for third-cycle studies is based on the student's potential to profit from such studies.

The assessment of potential in accordance with the first paragraph is made primarily on the basis of academic results from the first and second cycle. Special attention is paid to the following:

1. Knowledge and skills relevant to the thesis project and the subject of study. These may be demonstrated through documents appended to the application and at a possible interview.
2. An assessment of ability to work independently and to formulate and tackle research problems. The assessment could be made on the basis of the student's degree project and a discussion of this at a possible interview.
3. Written and oral communication skills
4. Other experience relevant to the third-cycle studies, e.g. professional experience.

## 6. Degree requirements

Third-cycle studies lead to a PhD or, if the student wishes or if it has been specified in the decision on admission, to a licentiate. The student also has the right to complete a licentiate as a stage in his or her third-cycle studies, but is not obliged to do so.

The requirements for a licentiate are

- passed courses of at least 30 credits, and

- a passed thesis of a scope corresponding to studies of at least 75 credits

The thesis and courses shall comprise at least 120 credits in total.

The requirements for a PhD are

- passed courses of at least 60 credits, and
- a passed thesis of a scope corresponding to studies of at least 150 credits

The thesis and courses shall comprise at least 240 credits in total.

### 6.1 Degrees awarded

The programme can lead to the following degrees:

*Teknologie licentiatexamen*/Licentiate in Engineering

*Teknologie doktorsexamen*/Doctor of Philosophy in Engineering

or:

*Filosofie licentiatexamen*/Licentiate of Philosophy

*Filosofie doktorsexamen*/Doctor of Philosophy

## 7. Course component

The programme is to include courses. For each course, an examiner shall be appointed at the department that delivers the course. The examiner shall draw up a written syllabus which states the course title in Swedish and English, the learning outcomes of the course, the course content and the number of credits.

The individual study plan is to include details of which courses the individual student shall or may include in his or her studies and how many credits for each course may be included in the degree. Courses taken at other faculties or higher education institutions may also be included in the study plan.

It is compulsory to participate in and pass the course Introductory Workshop for Newly Admitted Doctoral Students at LTH (*Introduktionskurs för nyantagna doktorander vid LTH*) GEM056F or the equivalent.

The courses are chosen in consultation between the doctoral student and the principal supervisor. They form an important instrument to supply both breadth and depth to the programme. It is therefore important that an appropriate balance is struck between:

- specialised courses in the subject and more general courses
- independent study courses and experimental courses
- courses shared with other students and courses that satisfy the doctoral student's individual interests

If a doctoral student at a higher education institution in Sweden has successfully completed a part of the third-cycle programme, he or she is entitled to transfer the credits awarded at another higher education institution. The same applies for doctoral students who have successfully completed parts of the programme at a higher education institution abroad. Any credits transfer is to be specified in the individual study plan.

The following courses are compulsory for a third-cycle degree:

### 7.1 Licentiate

At least 7.5 credits are to be covered by one of the following courses (or courses with corresponding content):

- Introductory course for postgraduate students in chemistry (1.5 credits)
- Environmental issues and hazards in the chemical research laboratory (2 credits)
- Technical writing for publication (6 credits)
- Communicating science (5 credits)
- Theory of science and research methods (4.5 credits)
- Numerical methods and uncertainty analysis

In addition, at least 7.5 credits are to be covered by one of the following courses (or courses with corresponding content):

- Nuclear magnetic resonance
- Nuclear spin relaxation
- The physical chemistry of proteins
- Statistical mechanics

### 7.2 Doctor of Philosophy

At least 7.5 credits are to be covered by one of the following courses (or courses with corresponding content):

- Introductory course for postgraduate students in chemistry (1.5 credits)
- Environmental issues and hazards in the chemical research laboratory (2 credits)
- Technical writing for publication (6 credits)
- Communicating science (5 credits)
- Theory of science and research methods (4.5 credits)
- Numerical methods and uncertainty analysis

In addition, at least 15 credits are to be covered by one of the following courses (or courses with corresponding content):

- Nuclear magnetic resonance
- Nuclear spin relaxation
- The physical chemistry of proteins
- Statistical mechanics

## 8. Thesis

The programme shall include a research project documented in a licentiate or doctoral thesis. An integral aspect of the research project is gaining knowledge of research methodology.

### 8.1 Research methodology

Research methodology includes the actions and methods necessary to carry out the research work. A foundation can be acquired in various ways – through courses as part of the course component or through participation in various activities that do not take the form of courses, as described in the section below.

Besides the general learning outcomes of the programme, the objective for general research methodology is for the doctoral student to be able to:

- plan, carry out and interpret scientific experiments and/or construct mathematical models of chemical and engineering processes
- draw conclusions from and evaluate complex data and/or evaluate the validity of results from computer simulations
- present academic work orally and in writing
- explain difficult technical concepts and processes in a comprehensible way to non-engineers and other audiences outside the University
- gain knowledge of information searching in databases and the opportunities presented by information technology in research

This is achieved through, among other things, participation in the following activities:

- discussions with supervisors, other doctoral students and other colleagues both within and outside the field
- active participation in seminars at the department and at other departments within and outside the University
- writing academic publications and participating in at least one scientific conference during the programme at which findings are discussed before an international academic audience
- presenting own and colleagues' results in recruitment projects and giving information about the research group's findings in popular science contexts in order to increase knowledge and understanding of chemical and engineering processes in wider society
- participation in quality enhancement activities such as knowledge exchange between doctoral students and research groups about experimental equipment, computer programs, etc.

## **8.2 Licentiate thesis**

The licentiate thesis is to be structured either as a short summary of at least one academic paper that the student has authored (compilation thesis) or as a continuous academic work (monograph). The thesis is to meet the standards required for publication in recognised scientific journals with a peer review system. For compilation theses, the contribution of the research student to articles with multiple authors is to be clear from the thesis. Any other projects in which the doctoral student has participated during his or her studies should also be reported in the thesis.

The research project is to be presented at a public seminar announced at least three weeks in advance. During this period, the thesis is to be available for scrutiny at the department.

The grade (pass or fail) is decided by the examiner. Two informal reviewers will be present at the seminar, at least one of whom is to be from outside the subject.

## **8.2 PhD thesis**

The PhD thesis is to be structured either as a short summary of research articles that the student has authored alone or jointly with others, where the doctoral student has made a significant independent contribution (compilation thesis), or as a continuous academic work (monograph). For compilation theses, the contribution of the doctoral student to articles with multiple authors is to be clear from the

thesis. Any other projects in which the doctoral student has participated during his or her studies should also be reported in the thesis.

The research articles are to meet the standards required for publication in recognised scientific journals with a peer review system. The PhD thesis is to be publicly defended.

## 9. Other rules and regulations

Resources permitting, doctoral students are to participate in undergraduate education through teaching, development of laboratory exercises, course materials, etc., and actively supervising degree projects. The maximum extent of these duties is to be 20% of the student's total working hours. A doctoral student admitted to third-cycle studies before the present general syllabus entered into force may choose to pursue his or her studies in accordance with either the old or the new syllabus.

Other matters are regulated in the general regulations for third-cycle studies laid down by LTH.

## 10. Transitional provisions

For doctoral students with an admission date of 1 January 2019 or later, it is compulsory to participate in and pass the course Introductory Workshop for Newly Admitted Doctoral Students at LTH (*Introduktionskurs för nyantagna doktorander vid LTH*) GEM056F or the equivalent in order to fulfil the requirements for the degree.