LUNDS UNIVERSITET
NATUR-
VETENSKAPLIGA
FAKULTETEN

SYLLABUS

Reg. no
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Faculty Board

General syllabus for third-cycle studies in Theoretical Physics with specialisation in Computational Biology, NATFBB02

This syllabus was approved by the Faculty Board on 16 December 2020 and applies to doctoral students admitted from 1 January 2021.

The syllabus is based on Chapter 6, Sections 1–11, 25–36, Chapter 7, Sections 34–41 of the Higher Education Ordinance (1993:100) and Annex 2, which is the Qualifications Ordinance.

1. Available degrees

Studies in line with this general syllabus can lead to one of the following degrees:

Doctor of Philosophy in Theoretical Physics with specialisation in Computational Biology / *Filosofie doktorsexamen i teoretisk fysik med inriktning beräkningsbiologi*

Licentiate of Philosophy in Theoretical Physics with specialisation in Computational Biology / *Filosofie licentiatexamen i teoretisk fysik med inriktning beräkningsbiologi*

In consultation with the Faculty of Engineering, LTH, the Faculty Board has decided (NA35 643/2005) that those who have been admitted to third-cycle studies at the Faculty of Science with a Degree of Master of Science in Engineering as a qualifying criterium can be given the title of Doctor of

Philosophy in Engineering or Licentiate of Philosophy in Engineering without special assessment.

2. Subject description

Theoretical Physics is engaged in constructing mathematical models and theories that describe physical reality. Complex phenomena are reduced to approximations and simplifications illustrating the essential mechanisms and connections. In order to refine and improve the models, their predictions are closely examined from analytical and numerical perspectives and compared with experimental observations.

Specialisation in computational biology

Biology and medicine are evolving into the quantitative disciplines that physics and chemistry have been for a long time. This development requires a mix of researchers from different areas to ensure success. This general syllabus applies to doctoral students with a first-cycle qualification in theoretical physics, as well as in other areas such as computer science, chemistry or biology. The research addresses areas similar to those above but only in very close cooperation with research teams in biomedicine or biology. Among the topics studied are the interaction between genes and proteins, the interaction between cells, disease progression and plant processes. More information is available on the website http://cbbp.thep.lu.se. This general syllabus with specialisation in computational biology applies to the research team in computational biology and biological physics.

3. Objectives

Third-cycle courses and study programmes are to be based fundamentally on the knowledge acquired by students during first and second-cycle courses and study programmes, or the equivalent. In addition to what applies to first and second-cycle level education, third-cycle education is to develop specific knowledge and skills needed to be able to conduct independent research.

The overall objectives for third-cycle education are defined in Annex 2 of the Higher Education Ordinance, the Qualification Ordinance.

3.1. Learning outcomes for a Degree of Doctor

Knowledge and understanding

For a Degree of Doctor the doctoral 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 a Degree of Doctor the doctoral student shall

– demonstrate the capacity for scholarly analysis and synthesis as well the capacity 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 advanced 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 their 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 advanced professional capacity.

Judgement and approach

For a Degree of Doctor the doctoral 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.

Subject-specific outcomes for a Degree of Doctor in Theoretical Physics with specialisation in Computational Biology

– be able to master the tools and methods of computational biology.

3.2. Learning outcomes for a Degree of Licentiate

Knowledge and understanding

For a Degree of Licentiate the doctoral 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 Degree of Licentiate the doctoral 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 advanced 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 advanced capacity.

Judgement and approach

For a Degree of Licentiate the doctoral student shall

– demonstrate the ability to make assessments of ethical aspects of their 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 their personal need for further knowledge and take responsibility for their ongoing learning.

Subject-specific outcomes for a Degree of Licentiate in Theoretical Physics with specialisation in Computational Biology

– be able to master several tools and methods of computational biology.

4. Entry requirements

The requirements for entry to third-cycle studies are that the applicant meets the general and specific entry requirements and is considered in other respects to have the ability required to benefit from the programme.

General entry requirements

A person meets the general entry requirements for third-cycle studies if the individual

1. has been awarded a second-cycle qualification, or
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 head of department can permit an exemption from the general entry requirements for an individual applicant, if there are special grounds.

Specific entry requirements

To be admitted to the third-cycle programme with a specialisation in computational biology the student must have a first-cycle qualification in biomedical subjects, chemistry, physics, mathematics or computer science and at least 60 second-cycle credits in bioinformatics, computational biology or associated subjects.

The specific entry requirement may also have been obtained through other equivalent education, which is assessed in each individual case.

5. Selection

In selecting between applicants who meet the requirements, their ability to benefit from the course or study programme shall be taken into account. The fact that an applicant is considered able to transfer credits from prior courses and study programmes or for professional or vocational experience may not alone give the applicant priority over other applicants.

The following selection principles are applied:

Results achieved in first and second-cycle (or equivalent) courses and study programmes. Broad, deep and relevant expertise from first and second-cycle (or equivalent) courses and study programmes. The quality of the degree project and other independent projects.

Other expertise or skills that are relevant to the chosen research specialisation.

Applicants who appear to be well-suited should, whenever possible, undergo an interview.

When recruiting and selecting students for third-cycle education, diversity and an even gender distribution must always be taken into account in accordance with Lund University's gender equality policy, equal opportunities policy and diversity plan. The under-represented gender is to be given priority among equally qualified candidates, unless special reasons dictate otherwise.

There must also be coherence between the student's research interests and the department's ability to provide competent supervision.

6. Degree requirements

The third-cycle study programme ends with a Degree of Doctor or, if the doctoral student so wishes or if this has been stated in the admission decision, with a Degree of Licentiate. The doctoral student is also entitled, but not obliged, to take a Degree of Licentiate as a stage in the education leading to a Degree of Doctor.

The Degree of Doctor comprises 240 credits while the Degree of Licentiate comprises 120 credits.

For a Degree of Doctor or Licentiate, the research student must have successfully completed a doctoral or licentiate thesis and passed all courses or other credit-earning components specified below.

6.1. Thesis

The programme must include a research project documented in a doctoral or licentiate thesis. This project is to be defended at a public defence (Degree of Doctor) or a public seminar (Degree of Licentiate), in both cases with a reviewer.

Doctoral thesis

The thesis must comprise at least 150 credits.

The doctoral thesis is to be a carefully thought-out and reasoned discussion of the candidate’s own work in relation to the broader research area, and can be produced either as a *compilation thesis* or a *monograph.*

A compilation thesis consists of attached copies of a number of research articles or manuscripts, along with a summarising chapter. The research articles are to be of a quality corresponding to the requirements for publication in recognised academic journals with peer review procedures, and it should be possible to distinguish the doctoral student’s contribution in the work.

It is rarely the case that the research papers in a compilation thesis are solely authored by the doctoral student. For this reason, importance should be attached to the summarising chapter that in part gives the doctoral student the opportunity to display an independent intellectual performance and in part enables assessment of the doctoral student's independent contributions. The summarising chapter is to provide an introduction to the papers and place the issues and results achieved into an overall context. The summarising chapter must therefore be written in a different format to the papers in the thesis, and it must be possible to read it as an independent academic text. The summarising chapter must not contain extensive copying of text, figures and tables from the constituent parts.

The monograph comprises a cohesive report detailing research tasks, issues, working methods, analysis, results and discussion. For monographs, it is particularly important that the candidate's own research is presented in such a way that the methods used, results achieved and conclusions drawn can be understood and assessed.

The thesis must relate to the Higher Education Ordinance's formulation of learning outcomes, which means the objectives of both the compilation thesis and the monograph are principally to:

- demonstrate current specialist knowledge and a broad and deep understanding of the research area
- demonstrate the ability to place the thesis into a broader theoretical and research context
- express clear objectives of the thesis and its most important hypotheses and issues
- demonstrate familiarity with the methods and analytical tools used within the research area, and demonstrate an ability to assess and evaluate them
- demonstrate an ability to reflect on the importance and limitations of the candidate's own research
- make a significant contribution to expanding knowledge in the field and identify needs for more knowledge.

The thesis must contain a popular science summary, which can be written in Swedish or English.

Licentiate thesis

The thesis must comprise at least 75 credits.

The licentiate thesis can be designed either as a summary of at least one academic article (or manuscript), which the doctoral student has written alone or jointly with others, or as a uniform, coherent academic work (monograph). The licentiate thesis is to be of a quality corresponding to the requirements for publication in recognised academic journals (with peer review procedures), and it should be possible to distinguish the various authors' contributions in the work. For details regarding the summary and monograph, see the compilation thesis and monograph section above.

6.2. Courses and other credit-earning components

In the subject of theoretical physics, courses or other credit-earning components comprising 60–90 credits are to be included for a Degree of Doctor and 30–45 credits are to be included for a Degree of Licentiate. The exact scope of the course requirement in addition to the thesis project is to be specified in the individual study plan. The number of credits required will be adapted to the qualifications of the doctoral student on admission.

Courses or other credit-earning components that are included in the programme may be completed both at or outside Lund University.

6.2.1 Compulsory courses

- Introduction to the Department (at least 1 credit)
- Faculty-wide Introductory Course for Doctoral Students (0.5 credits)
- Research Ethics (3 credits)

Basic training in teaching and learning in higher education corresponding to 3 credits is compulsory for doctoral students who teach.

6.2.2 Basic knowledge

The following courses may only be replaced with other courses if there are strong reasons for doing so.

– Statistical Mechanics (7.5 credits)
– Computational Physics (7.5 credits)
– Computational Biology Programming (7.5 credits)
– Basic Cellular and Molecular Biology or Biophysics (7.5 credits)

The number of credits required (0–30 credits) will be adapted to the qualifications of the doctoral student on admission.

For a Degree of Licentiate

Knowledge corresponding to 0–22.5 credits from the relevant specialisation above. The number of credits required will be adapted to the qualifications of the doctoral student on admission.

6.2.3 Specialised and broadened knowledge

This category refers to specialised studies within the area of the thesis and studies that complement the doctoral student's general knowledge of theoretical physics or associated subjects.

Active participation in summer schools and conferences also counts as specialised knowledge (1.5 credits per week). The assessment is based on an oral presentation (at a seminar) of parts of the content of the summer school or conference.

For a Degree of Doctor

At least 45 credits.

For a Degree of Licentiate

At least 7.5 credits.

6.2.4 Basic knowledge

This category refers to general subjects of relevance to the research student, such as

– Introduction to Research Studies (1.5 credits) (compulsory)
– Introduction to Teaching Methods (3 credits) (compulsory for doctoral students who teach)

– Research Ethics
– Publication Methodology
– Academic Writing
– Project Management
– Research Communication

For a Degree of Doctor

No more than 15 credits. Active participation in interaction with wider society (e.g. popular science presentations) will count for up to 3 credits in this category.

For a Degree of Licentiate

No more than 7.5 credits. Active participation in interaction with wider society (e.g. popular science presentations) will count for up to 1.5 credits in this category.