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LUND UNIVERSITY
Faculty of Science

Faculty Board

General Syllabus for Third-Cycle Studies in Theoretical Physics

Specialisation in Theoretical Physics, NATFTF01

Specialisation in Computational Biology, NATFBB01

This is a translation of the general syllabus approved in Swedish.

This syllabus was approved by the Board of the Faculty of Science on 18 December 2013 and applies to third-cycle students admitted from 1 January 2014.

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

1. Available degrees

The programme described in this syllabus can lead to one of the following degrees:

Doctor of Philosophy in Theoretical Physics

Doctor of Philosophy in Theoretical Physics specialising in Computational Biology

Licentiate of Philosophy in Theoretical Physics

Licentiate of Philosophy in Theoretical Physics specialising in Computational Biology

In order to avoid confusion, "specialisation in theoretical physics" refers below to all cases not specialising in computational biology.

In consultation with the Faculty of Engineering/LTH, the Faculty Board has decided (NA35 643/2005) that students admitted to third-cycle studies at the Faculty of Science on the basis of an MSc in Engineering shall be entitled to be awarded the degrees of Doctor of Philosophy in Science or Licentiate of Science without special application.

2. Subject description

Theoretical Physics is engaged in constructing mathematical models and theories of 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 Theoretical Physics (NATFTF01)
The basic tools of Theoretical Physics are classical mechanics, electrodynamics, statistical mechanics, relativity theory and quantum mechanics. A researcher in Theoretical Physics masters these tools and can apply them to issues far beyond the realm of traditional physics by establishing connections and analogues.

Research in Theoretical Physics at the Department of Astronomy and Theoretical Physics is currently conducted in two different research teams.

The Theoretical High Energy Physics team studies the smallest components of nature, focusing on phenomenological aspects. Research is conducted at the interface of theories and experiments in close contact with research teams at the major accelerator experiment stations around the world. More information is available on the website http://particle.thep.lu.se.

The Computational Biology and Biological Physics team studies the properties and dynamics of proteins, and the interaction between proteins, genes and cells, among other things. Research is often conducted in close cooperation with research teams in, for example, biology, chemistry, nanophysics or biomedicine. More information is available on the website http://cbbp.thep.lu.se. This general syllabus applies to both research teams within the specialisation in theoretical physics.

Specialisation in Computational Biology (NATFBB01)
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. The present general syllabus applies to students with a degree in theoretical physics but also in areas such as computer science, chemistry or biology. The research addresses the areas specified above but only in cooperation with research teams in biomedicine and 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 applies to the research team in Computational Biology and Biological Physics within the specialisation in computational biology.

3. Objectives

Third-cycle courses and study programmes shall be based fundamentally on the knowledge acquired by students in first- and second-cycle courses and study programmes, or its equivalent. In addition to the requirements for first- and second-cycle courses and study programmes, third-cycle courses and study programmes shall develop the knowledge and skills required to be able to undertake autonomous research.

The general outcomes for third-cycle courses and study programmes are defined in the Higher Education Ordinance Annex 2 Qualifications Ordinance.

3.1. Outcomes for a degree of Doctor

Knowledge and understanding

For the degree of Doctor 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 the third-cycle student shall

– demonstrate the capacity for scholarly analysis and synthesis as well as the ability 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 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.

Outcomes for a degree of Doctor in Theoretical Physics specialising in Theoretical Physics

– be able to master the tools and methods of Theoretical Physics.

Outcomes for a degree of Doctor in Theoretical Physics specialising in Computational Biology

– be able to master the tools and methods of Computational Biology.

3.2. Outcomes for a degree of Licentiate

Knowledge and understanding

For a Degree of 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 Degree of Licentiate the third-cycle student shall have:

– 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 Degree of 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.

Outcomes for a degree of Licentiate in Theoretical Physics specialising in Theoretical Physics

– be able to master the tools and methods of Theoretical Physics.

Outcomes for a degree of Licentiate in Theoretical Physics specialising in Computational Biology

– be able to master the tools and methods of Computational Biology.

4. Admission requirements

The requirements for admission to third-cycle courses and study programmes are that the applicant meets the general and specific entry requirements that the higher education institution may have laid down, and is considered in other respects to have the ability required to benefit from the course or study programme.

General admission requirements

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

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 may permit an exemption from the general entry requirements for an individual applicant, if there are special grounds.

Transitional provision: Those who meet the general admission requirements for doctoral programmes before 1 July 2007 will also be considered to meet the general admission requirements for third-cycle courses and study programmes until the end of June 2015.

If a specific number of credits or a qualification from previous first- or second-cycle courses and study programmes are required for admission to third-cycle courses and study programmes, those with corresponding credits or qualifications from undergraduate programmes awarded before 1 July 2007 will also be eligible.

Specific admission requirements

To be admitted to the third-cycle programme specialising in Theoretical Physics the student must have a degree in physics, theoretical physics or engineering physics and 60 second-cycle credits in physics, theoretical physics or associated subjects, but with no more than 15 credits in the latter.

To be admitted to the third-cycle programme specialising in Computational Biology the student must have a degree in biomedical subjects, chemistry, physics, mathematics or computer science and 60 second-cycle credits in bioinformatics, computational biology or associated subjects.

Equivalent knowledge acquired through corresponding programmes will be assessed individually.

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. However, 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 criteria will be applied:

Study record from undergraduate and Master's courses or the equivalent. The breadth, depth and relevance of undergraduate and Master's courses or the equivalent. The quality of the degree project and other independent work.

Other knowledge and skills of relevance to the research specialisation.

Suitable candidates should be called to an interview, if possible.

The recruitment and selection to third-cycle studies must always take diversity and gender balance into account, in compliance with the Lund University gender equality policy, equal opportunities policy and diversity plan. The underrepresented gender should always be given precedence in cases of equal qualifications, unless there are valid reasons to the contrary.

Furthermore, it must be possible for the department to offer expert supervision in the student's research specialisation.

6. Degree requirements

The completion of the third cycle programme results in a degree of Doctor of Philosophy or, if the student so wishes or if this is stated in the admission decision, a degree of Licentiate. The student may also but is not obliged to complete a degree of Licentiate as a stage in the third-cycle programme.

The degree of Doctor comprises 240 credits and the degree of Licentiate 120 credits.

For a degree of Doctor or Licentiate the research student must have successfully completed a PhD or Licentiate thesis and passed all courses and other components specified below. The head of department (or person to whom the task has been delegated) is to check and determine if all the formal requirements of a degree of Doctor or Licentiate have been satisfied.

6.1. Thesis

The programme is to include a research project documented in a PhD or Licentiate thesis. The thesis is to be defended orally at a public defence and reviewed by a faculty examiner (opponent).

PhD thesis

The PhD thesis is to comprise at least 150 credits.

The PhD thesis can be designed as *compilation thesis* or as a *monograph*.

A compilation thesis consists of copies of a number of research articles or manuscripts and a summarising chapter. The articles may be written by the doctoral student individually or in cooperation with others, but the summarising chapter must be written individually by the doctoral student. The research articles must be of a quality required for publication in recognised peer-reviewed journals and it must be possible to determine the contributions of different authors. The summarising chapter is to consist of an introduction to the research area of the thesis and a presentation and discussion of the findings of the articles. The presentation and discussion shall be written in a form and style that is independent and different from the articles. This makes it possible to situate the findings in a wider context.

A monograph thesis is a unified report including descriptions of the research issue, research questions, methods, analysis, findings and discussion.

Licentiate thesis

The Licentiate thesis is to comprise at least 75 credits.

The Licentiate thesis can be designed as a summary of at least one research article (or manuscript), written by the student individually or in cooperation with others, or a unified research report (monograph). The thesis must be of a quality required for publication in recognised peer-reviewed journals and it must be possible to determine the contributions of different authors. For more information on summary and monograph theses, please see compilation thesis and monograph thesis above.

6.2. Courses and other programme components

The courses and other components of the third-cycle programme in Theoretical Physics are to comprise 60–90 credits for a degree of Doctor and 30–45 credits for a degree of Licentiate. The exact number of credits required for courses is to be stated in the individual study plan and to be determined by the supervisor and head of research or director of studies. The number of credits required will be adapted to the qualifications of the student on admission.

The required courses and other components can be offered at Lund University or at other higher education institutions. The head of department (or person to whom the task has been delegated) determines the number of credits that can be transferred from courses and other components offered at other faculties or higher education institutions.

The introductory course of at least 1.5 credits, of which 0.5 credits consist of the faculty-wide introductory course to PhD studies, is compulsory for all research students and Introduction to teaching methods (3 credits) is compulsory for all research students who teach.

At least two thirds of the credits shall be obtained through courses.

6.2.1 Basic knowledge

The following courses can only be replaced with other courses if there are strong reasons and following a decision by the supervisor and head of research or director of studies.

For a degree of Doctor in Theoretical Physics specialising in Theoretical Physics

- Classical mechanics (7.5 credits)
- Electrodynamics (7.5 credits)
- Statistical mechanics (7.5 credits)

If the student lacks second-cycle credits in quantum mechanics, he or she must select a course of 7.5 credits in the subject. The total scope is 0–30 credits depending on the qualifications of the student on admission.

For a degree of Doctor in Theoretical Physics specialising in Computational Biology

- Statistical mechanics (7.5 credits)
- Computational physics (7.5 credits)

– Computational biology programming (7.5 credits)
– Basic cell or molecular biology or biophysics (7.5 credits)

The total scope is 0–30 credits depending on the qualifications of the student on admission.

For a degree of Licentiate (both specialisations)

Knowledge corresponding to 0–22.5 credits from the relevant specialisation above. The total scope will be determined on the basis of the student's qualifications on admission.

6.2.2 Specialised and broadened knowledge

This category refers to specialised studies within the area of the thesis and studies that will complement the student's general knowledge of theoretical physics or associated subjects. The courses will be determined in consultation with the supervisor and head of research or director of studies.
Active participation in graduate summer schools and conferences will also count as specialised knowledge (1.5 credits per week). The assessment will be based on an oral report (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

6.2.3 General 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 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 up to 1.5 credits in this category.