



General syllabus for third-cycle studies in theoretical physics

For a degree of doctor

Scope: 240 higher education credits

The Degree: Degree of Doctor

Study level: Third-cycle

Established by: General syllabus established by the Faculty of Science and Technology Board on April 21st, 2021

Enters into force: April 21st, 2021

Responsible body: Faculty of Science and Technology

1. Field of Study

In the sense of this syllabus, theoretical physics is the branch of science that develops and employs mathematical models and abstractions of physical objects and systems to understand, explain, and predict natural phenomena. These models aim to advance the current understanding of the basic principles behind these phenomena, and solve applied problems bridging physics and engineering. Theoretical Physics, as defined here, also encompasses efforts to explain phenomena in other branches of science using models and numerical methods developed in theoretical physics.

To receive a doctoral degree in theoretical physics, the student must acquire good overall expertise in the field of study and the methods and questions pushing it forward. This is demonstrated by the ability to conduct research that makes significant contributions.

2. Learning outcomes

2.1 Description of education at current level

The education is at the research level. The goals for postgraduate education are found in the Higher Education Act, Chapter 1, Section 9a.

2.2 Learning outcomes for the current degree

The national learning outcomes for the degree can be found in Appendix 2 of the Higher Education Ordinance.

The learning outcomes for the degree of doctor in theoretical physics are those specified by the Higher Education Ordinance, Chapter 6, Sections 4 and 5 (see Appendix A), where the terms research field and area of specialization are to be interpreted in accordance with the preceding section. These learning outcomes are complemented by a gender and equal opportunities perspective which is integrated in the content and organization of the programme. It provides the student with additional insights into how inequality by traditional structures and perspectives can



be counteracted.

3. Entry requirements and prior knowledge required

To be admitted for studies at third-cycle level the applicant is required to meet the general entry requirements and the specific entry requirements that the board of the Faculty of Science and Technology Board has prescribed, and shall be considered as otherwise possessing that required to benefit from the studies. (Higher Education Ordinance, Chapter 7, Section 35)

General entry requirements

To fulfil the general entry requirements, the applicant must have qualifications equivalent to a completed degree at second-cycle level, or completed course requirements of at least 240 ECTS credits including at least 60 ECTS credits at second-cycle level. The board of the Faculty of Science and Technology may, in the case of a specific applicant, consent to an exemption from the general entry requirements, if there are special reasons to do so. (Higher Education Ordinance, Chapter 7, Section 39)

Specific entry requirements

To fulfil the specific entry requirements to be admitted for studies at third-cycle level within the subject of theoretical physics, the applicant is required to have completed courses within the field of physics comprising at least 120 credits.

If special reasons exist, for example, if the planned research work has a strong interdisciplinary element, then the Head of Department may consent to up to 30 of these 120 credits being replaced by courses within another relevant field of natural science.

The prior knowledge requirements in respect of the above are also deemed to be fulfilled by applicants who in some other system either within Sweden or abroad have acquired largely equivalent skills.

4. Selection process

A selection process involving applicants who meet the entry requirements will be conducted with reference to their ability to benefit from third-cycle studies, and is based on the following assessment grounds:

- personal suitability
- previous study results and
- other merits

However, applicants must not be given preference over other applicants in the selection process solely based on the assessment that the applicant can receive accreditation for previous education or professional activities. (Higher Education Ordinance, Chapter 7, Section 41)

Decisions regarding admissions to studies at third-cycle level concluding in a doctoral degree are made in accordance with Umeå University's delegation of authority.

5. Contents and scheduling

5.1 General

An individual study plan is to be established for each doctoral student which shall give details of financing, supervision, courses, thesis-related work, etc. For a degree of doctor to be awarded, the studies shall entail 240 ECTS credits. A doctoral student can, if desired, pursue a licentiate degree as an intermediate goal.

Studies at third-cycle level that are to be concluded with a doctoral degree shall comprise a net study period of four years. They consist of a course component of 90 ECTS credits and an academic thesis 120 ECTS credits. For a licentiate degree, a total of 120 credits is required, with a course component of at least 45 credits and a licentiate thesis of at least 60 credits.

5.2 Contents

Studies towards the degree of doctor in theoretical physics consist of courses and thesis work. The course part consists of a fixed set of mandatory courses and a variable number of courses individually determined according to the doctoral student's needs. The mandatory courses convey generic skills, provide an overview of the field as such and its scientific methods, and take up questions regarding gender issues and equal terms as integral parts. Depending on the specialization and the doctoral students' previous knowledge, the admission decision shall specify additional mandatory course requirements if such is deemed necessary to guarantee that the student achieves a good overall expertise of the subject, and deep knowledge in their particular area of specialization.

The character of the education is highly international. Doctoral students participate in international collaborations, and are expected to present their research results in international contexts.

5.2.1 Courses

The following courses are mandatory for all doctoral students in theoretical physics:

Courses developing general competence:

- *Introduction to Doctoral Studies at the Faculty of Science and Technology*, 1 ECTS credit
- *Writing Science*, 5 ECTS credits
- *Oral Presentation*, 1 ECTS credit
- *Philosophy of Science*, 2 ECTS credits
- *Introduction to Research Ethics*, 2 ECTS credits

Additional mandatory courses for the individual doctoral student can be specified in the admission decision. The remaining course requirements are satisfied via elective courses which broaden or deepen the doctoral student's expertise in the subject or provide additional generic skills. For a licentiate degree, four courses are mandatory. These are *Philosophy of Science*, *Introduction to Research Ethics*, *Writing Science*, and *Introduction to Doctoral Studies at the Faculty of Science and Technology*.

5.2.2 Doctoral thesis

The doctoral thesis comprises at least 120 ECTS credits. It may either take the form of a single coherent work (a monograph) or a compilation consisting of an introduction, a number of



scientific papers, and a summary and discussion of the papers which includes a description of the author's contributions to each paper (compilation thesis). In both cases the number of ETCS credits of the thesis is to be indicated. Further, the thesis shall contain a popular scientific description aimed at readers outside academia.

With the doctoral thesis the PhD student demonstrates that the goals for the degree of doctor have been met. The doctoral thesis shall be defended orally in public, resulting in an assessment with one of the following grades: G (Pass) or U (Fail). When setting the grade, the grading committee shall pay attention to both the content of the thesis and its defense.

6. Examination

The degree of doctor is awarded upon completion of third-cycle studies equivalent to 240 ECTS credits, provided that the applicant has received the grade *Pass* in all mandatory parts. In particular, this includes the public defense of the doctoral thesis and its approval by the grading committee. Degree certificates are issued following application to Student Services/Examina.

7. Other instructions

The provisions that apply in respect of third-cycle studies can be found in:

- The Higher Education Ordinance: Chapter 5 Employment of doctoral students, Chapter 6 Courses and study programmes, and Chapter 7 Admission to courses and study programmes, Annex 2 Qualifications ordinance.
- Admission regulations for doctoral studies at Umeå University.
- Local system of qualifications at Umeå University.
- Regulations for doctoral studies at Umeå University.
- Handbook for postgraduate students at the Faculty of Science and Technology at Umeå University.



Appendix A

Learning outcomes for the degree of doctor

(Higher Education Ordinance, Chapter 6, Sections 4 and 5)

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 specialized 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 dissertation the ability to make 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 in 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 specialized insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how this is used.