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General syllabus for doctoral (third-cycle) studies in Experimental Physics at Luleå University of Technology

Decided by the Chair of the Board of Faculty of Science and Technology 29 January 2024.

1. Subject description

English name: Experimental Physics

The subject comprises experimental physics with an emphasis on material science research on micro and nano length scales, and that are closely and widely related to applications and applied research.

2. Programme aim and intended learning outcome

The aim of the doctoral (third-cycle) studies in Experimental Physics at the University is to give the doctoral student specialised knowledge in Experimental Physics, in-depth knowledge of different research methods and a good understanding of the challenges related to research and its practical application. The overall objective of the programme is that the doctoral student develops into a critical and autonomous researcher in Experimental Physics, able to plan and carry out research projects. The doctoral student shall fulfil all the qualitative targets specified in the Higher Education Ordinance as well as in the locally decided qualitative targets, if any (see attached Annex A).

3. Admission requirements and selection

3.1 General entry requirements

An applicant meets the general entry requirements for doctoral (third-cycle) studies if he or she has been awarded a Master's (second-cycle) qualification, has satisfied the requirements for courses comprising at least 240 credits, of which at least 60 second-cycle credits, or has acquired substantially equivalent knowledge in another way, in Sweden or elsewhere (Higher Education Ordinance (2010:1064) Chapter 7 Section 39).

3.2 Specific entry requirements

In addition to the requirement for basic qualifications, an applicant meets the specific requirements if he or she has a background in the following field of study: Physics, Chemistry, Materials Science & Engineering or equivalent, and he or she has very good command of oral and written communication in English.

3.3 Selection

In selecting among applicants who meet the requirements, their ability to benefit from the course or the study programme shall be taken into account. However, the fact that an applicant may be credited for previous courses and study programmes or for professional or vocational experience may not alone give the applicant priority over other applicants (Higher Education Ordinance

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(2010:1064) Chapter 7 Section 41). The University's local guidelines in the Admissions procedure for doctoral (third-cycle) studies must also be applied.

The following criteria will be used in the selection of applicants for doctoral (third-cycle) studies in Experimental Physics.

- Knowledge and skills relevant to the specific project
- The quality of the applicant's degree project
- Experience on materials preparation and characterization techniques is advantageous
- Personal qualities relevant to education for third-cycle education

4. The degree

The doctoral (third-cycle) studies lead to a Degree of Doctor. Within Experimental Physics, a student admitted to doctoral studies has the right to be awarded a licentiate degree after having completed at least 120 credits of the programme leading to a Degree of Doctor.

4.1 Degree requirements

For a Degree of Doctor, the doctoral student shall

- have been awarded a pass grade for courses of at least 60 credits
- have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

The thesis and the courses shall together amount to 240 credits for a Degree of Doctor.

For a Degree of Licentiate, the doctoral student shall

- have been awarded a pass grade for courses of at least 35 credits.
- have been awarded a pass grade for a licentiate thesis of at least 60 credits.

The thesis and the courses shall together amount to 120 credits for a Degree of Licentiate.

4.2 Titles of degree

- After the completion of the Degree of Doctor in Experimental Physics the doctoral student is awarded the title Doctor of Philosophy in Science.
- After the completion of the Degree of Licentiate in Experimental Physics, the doctoral student is awarded the title **Licentiate of Science**.

A request of a title of degree other than the stipulated may be submitted in accordance with laid down guidelines.

5. Programme structure and implementation

5.1 Programme scope and structure

The doctoral (third-cycle) programme includes two blocs; courses and thesis work. The programme comprises four years (two years for the licentiate degree). In case the doctoral student has a doctoral studentship and carries out departmental duties to a certain extent (no more than 20% of the whole programme), a corresponding prolonged period may be approved.

5.2 Individual study plan and supervision

An individual study plan outlining the implementation of the studies is drawn up for each doctoral student. The plan is established in consultation with the supervisor and is decided by

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the Head of Department by delegation of the Vice-Chancellor. The plan is reviewed and revised at least once a year.

The Head of Department shall appoint at least two supervisors, one of whom is appointed principal supervisor, for each doctoral student. The person appointed principal supervisor shall have at least qualifications required for appointment as a docent and be employed by the University. A principal supervisor who no longer meets the job requirements may continue as supervisor until the doctoral student completes his or her studies, by an individual agreement with the relevant department. The doctoral student is entitled to supervision during the studies, unless the Vice-Chancellor has decided otherwise in accordance with the Higher Education Ordinance (2010:1064) Chapter 6 Section 30. A doctoral student who so requests may have another supervisor (Higher Education Ordinance (2010:1064) Chapter 6 Section 28). The request does not need a justification.

5.3 Courses

The individual study plan shall specify the courses to be included in the doctoral student's education. The goal attainment is examined according to the examination procedure specified in the course syllabus. Credits may be transferred in accordance with the local guidelines in the Admissions procedure for doctoral (third-cycle) studies.

Courses, as specified in the three categories below, may be part of a Degree of Licentiate or of Doctor in Experimental Physics.

1. Courses in Experimental Physics.
2. Courses in related fields, for example, Computational and Theoretical Physics, Chemistry, Materials Science & Engineering, or courses of immediate relevance for the doctoral student's research specialisation.
3. General third-cycle courses, for example, research methodology, theory of knowledge, information retrieval and pedagogy.

A Degree of Licentiate must comprise at least 35 credits within category 1 (Experimental Physics). A Degree of Doctor must comprise at least 45 credits within category 1 (Experimental Physics), and maximum 15 credits within category 3 (general third-cycle courses).

Courses specific to the subject area are specified in the Individual Study Plan (ISP) along with generic courses containing research ethics and scientific writing (the specific courses related to the subject area should amount for majority of points of total course points indicated in ISP). Knowledge about gender equality must be ensured during the doctoral student period through workshops, seminars or the like.

5.4 Thesis

The thesis may take the form of either a single coherent work (a monographic thesis) or a compilation comprising a number of scientific articles interrelated by an introductory summary chapter (a compilation thesis). Quality and scope requirements for the research activities do not differ between the two alternatives. The scientific articles or, as appropriate, the monograph must be of such quality that they meet reasonable requirements for publication in a peer-reviewed scientific forum.

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The number of articles may vary depending on the student's own contribution to each article and on the scope and scientific contribution of the articles. A normal compilation Doctoral thesis consists of four to six articles of which at least two have been accepted for publication in international scientific journals and/or books, and two to four other articles that meet the standards for international scientific publication. A compilation thesis shall clearly show the doctoral student's individual contribution and the contribution of the other co-authors. A normal compilation Licentiate thesis consists of two to three articles of which at least one has been accepted for publication in international scientific journals and/or books.

The education is planned in such a way that the doctoral student will be able to appropriate in-depth knowledge in Experimental Physics. This is executed through the choice of selected courses coupled with an advanced scientific research project. The doctoral student will be given the opportunity to develop their knowledge of planning and executing research projects, as well as to publish and present scientific results. This training is acquired by the doctoral student through learning how to carry out literature research and analysis, presenting their research results at international conferences, by gaining larger responsibilities in writing their own publications, by being in charge of the publication process, and by being part of the work involved in preparing, submitting and managing research applications.

The student will be integrated in a stimulating research environment composed of students at different career level, and several senior researchers/supervisors. The student will be also connected with the research network at the national and international level, and part of their research will be carried out in the framework of scientific collaborations, boosting the international side of career development, both from the viewpoint of research and of labor market. After completing their education, they will be able to partake in world class research projects in order to disseminate research results and to interact with the major players within industry and academia both nationally and internationally.

The introductory summary chapter shall include a separate section describing the doctoral student's contribution to the articles.

The doctoral thesis shall be defended at a public defence seminar. The grades for the thesis are either 'pass' or 'failed'. When grading the thesis, the content and the defence of thesis shall be taken into account. The grade of a doctoral thesis is decided by an examining committee, appointed anew for each thesis.

A doctoral student wanting to be awarded a Degree of Licentiate shall, after consultation with his or her supervisor, request approval from the responsible Head of Department. The doctoral student defends his or her licentiate thesis at a licentiate seminar after which the thesis is graded 'pass' or 'failed'. When grading the thesis, the content and the defence of the thesis is taken into account. An examiner, appointed by the Head of Department, grades the licentiate thesis.

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6. Entry into effect and interim regulations

The previous general syllabus will cease to apply for third-cycle students who are admitted to studies at third-cycle level after 2024-01-29.

If agreed between the third-cycle student and the supervisors, the new general syllabus (LTU-4768-2023) may be used as a steering document for a previously admitted third-cycle student.

It must be documented in the third-cycle student's individual study plan which general syllabus that applies.

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ANNEX: QUALITATIVE TARGETS

Qualitative target in accordance with the Higher Education Ordinance (HF)

Degree of Doctor

Knowledge and understanding

For the Degree of Doctor, the doctoral student shall

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

Competence and skills

For the Degree of Doctor, the doctoral student shall

- demonstrate the capacity for scholarly analysis and synthesis as well as 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 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 doctoral student shall

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- 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.

Research thesis (doctoral thesis)

For the Degree of Doctor, the doctoral student shall have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

Degree of Licentiate

Knowledge and understanding

For a Degree of Licentiate, the doctoral student shall

- demonstrate knowledge and understanding in the research domain 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 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 another qualified capacity.

Judgement and approach

For a Degree of Licentiate, the doctoral student shall

- demonstrate the ability to make assessments of ethical aspects of his or her own research,

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- 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, and
- demonstrate the ability to identify the need for further knowledge, and take responsibility for his or her ongoing learning.

Thesis

For a Degree of Licentiate, the doctoral student shall have been awarded a pass grade for a research thesis of at least 60 credits.