Materials Science

/Materialvetenskap/

SCB-codes: 21001, 10304, 20599

The governing rules common for all PhD Studies at Linköping University's Institute of Technology can be found in the faculty's *Study Handbook for PhD Studies*. Some overall rules can also be found in Linköping University's local rules and regulations as well as in the Higher Education Act and the Higher Education Ordinance.

General description of the research area

The research conducted in the area of Materials Science, with a special emphasis on condensed matter physics and nano technology, is focused on experimental research work on the material, but also including computations and modeling of these materials. The graduate training includes simulations, fabrication and characterization of materials. Various properties of the material, such as electronic, optical, structural, mechanical and transport properties, are studied. The research realm also includes applications / devices based on these materials. Our graduated materials scientists will master key links between growth, structure and properties of advanced functional and structural materials.

Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*.

Specific eligibility requirements

Admission to PhD Studies in the research area of Materials Science requires completion of courses of at least 60 ECTS at the master level in a relevant area of Materials Science. These 60 ECTS should include an independent project (degree project) of at least 30 ECTS in a field relevant to the subject of PhD studies.

Degree

PhD studies in Materials Science lead to a Degree of Doctor or a Degree of Licentiate. The Degree of Licentiate comprises 120 ECTS, of which courses correspond to 45 ECTS and the licentiate thesis corresponds to 75 ECTS. The Degree of Doctor comprises 240 ECTS, of which courses correspond to 90 ECTS and the doctoral thesis corresponds to 150 ECTS.

Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook*'s appendix A).

PhD studies in Materials Science will equip the PhD student with the knowledge and skills to fulfill all the degree outcomes. The PhD studies will endow the PhD student with a broad knowledge and understanding of his/her area of research. The PhD student will acquire a deep knowledge and understanding of his/her research area, and in particular within his/her research specialisation, by, for example, actively participating in in-depth courses in his/her area of research.

The PhD student will develop familiarity with scientific methodology through his/her own research and by completing a mandatory course in research methodology. The PhD student will develop judgement and approach in the research area through completing courses in research ethics, participating in seminars/seminar series and conferences within his/her specialisation, and working together with the research group and with collaboration partners. PhD students will demonstrate their intellectual autonomy by, among other things, writing a thesis.

The PhD studies are structured in a way so that two years of studies are required for a Degree of Licentiate, and four years of studies are required for a Degree of Doctor. This assumes that the student not only meets the prerequisite knowledge but also studies full-time. If teaching or departmental duties are included in the PhD position, the period of study required to receive a Degree of Doctor can be extended up to one year, and the period of study required to receive a Degree of Licentiate can be extended up to half a year. PhD studies consist of courses, thesis work and literature studies in connection to the thesis.

The PhD studies will endow the PhD student with a broad knowledge and understanding of his/her area of research through, for example, work with various research projects, study of basic and wide-ranging courses (see the section below on Courses), participation in conferences and workshops, and participation in for example the work of the graduate school Agora Materiae.

Below are some examples of how PhD students in the research area of Materials Science acquire skills and competencies:

- By independently planning and carrying out experimental research
- By analysing research results achieved
- By participating in the research group's seminars, presentations and discussions. This includes regularly reporting the attained results, presenting plans for continued work and holding critical discussions of the research work.
- By participating in relevant national and international conferences and presenting at such fora research results, orally and/or as poster sessions.
- By describing and formulating research results in research reports and scientific articles, initially under the guidance of more experienced researchers and eventually by independent initiative
- By critically analysing and reviewing reports and articles produced by others
- By participating in the work of for example the graduate school Agora Materiae.
- By participating in so-called non-core subject courses such as presentation techniques, leadership, management, patent and intellectual property law, methodology/ethics, pedagogy (mandatory for PhD students who teach)

Thesis

The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*.

a) Doctoral thesis

The extent of the scientific research should correspond to at least 2,5 years of full-time research work. The research results are submitted in a doctoral thesis, which can be presented either as a continuous piece of work or as a compilation of scientific essays.

The thesis should be of such level of quality that it, in its entirety, can be judged to meet reasonable requirements to be accepted for publication in scientific journals of good quality.

In a compilation thesis, the greater part of the included works should be accepted for publication or published.

b) Licentiate thesis

The extent of the thesis work should correspond to at least 1-1,5 years of full-time work. The thesis can consist of one or several scientific essays and/or an investigative report conducted on scientific grounds.

Both types of theses can be done as part of teamwork, but the student's contribution should consist of independent work and be specifically accounted for in the thesis' introduction.

Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year.

Supervision

General rules governing supervision of PhD studies can be found in Chapter 4 of the *Study Handbook for PhD Studies* and in the *Policy for the Supervision of PhD Studies.*

At the beginning of PhD studies, a main supervisor will be appointed for each PhD student. Moreover, one or more co-supervisors will be appointed. The supervisors' roll is to guide the student during the period of study regarding, among other things, course selection and selection of research projects. The student and the supervisors should meet regularly to discuss and consult on the progress of the research work.

Courses

For all the course requirements, please see the section on Degree. At least 68 ECTS in the research area's core subjects (including any accredited components) are required for a Degree of Doctor. At least 30 ECTS in the research area's core subjects (including any accredited components) are required for a Degree of Licentiate.

Faculty course requirements

Scientific theory, methodology and ethics
All PhD students admitted as of 1 January 2010 should complete mandatory courses as decided by the faculty in methodology and ethics, or be deemed to have equivalent competencies, in order to receive a degree.

Pedagogic studies
All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

Courses within the core of the research area
Examples of courses within the core of the research area of Materials Science are Computational Methods in Materials Science, Analytical Methods in Materials Science, Electrodynamics / Magnetism, Dislocations /Defects, Solid State Physics I & II, Group Theory, Semiconductor Physics I & II, Device Physics, Crystal Growth / Epitaxy, Quantum Mechanics / Dynamics / Chemistry, Material Optics, Material Chemistry, Material Physics, Raman and IR Spectroscopy, Nano Physics, Statistical and Thermal Physics, Thinfilm Physics, Density Functional Theory, Surface Physics, XRD.

Courses within non-core subjects
Besides courses within the specialised research area, the PhD student can also select courses in non-core fields (e.g. presentation techniques, leadership, intellectual property law, project management, etc.).

Accreditation
Master courses that are equivalent to at most half of the course requirements for the degree (in any case at most 30 ECTS), that do not form part of the basic or specific eligibility requirements for the specialisation, and that are relevant to the PhD studies may be counted toward the degree. The PhD student should submit an application for accreditation using the appropriate form; the application is to be approved or rejected by the main supervisor, and a positive decision on accreditation can be made by the Director of PhD Studies at the department. A decision to reject an application for accreditation may not be made by the Director of PhD Studies at the department, rather, such a decision can only be made by the faculty's Board of PhD Studies.

Other courses and activities
Even courses taken at other departments or universities, such as summer schools, may be included, just as self-study within special fields. Likewise, special activities such as symposia, seminars, contract research, etc. may be reported and included as components of the PhD studies.

Transitional provisions
Changes to the general study syllabus do not apply to those who have already been admitted to PhD studies in the research area. A change to the new general study syllabus may however be approved if both the main supervisor and the PhD student agree. In such a case, this should be documented in the individual study plan.