



Faculty of Health, Science and Technology

Curriculum for Third-Cycle Education in Materials Engineering

(Forskarutbildning I Materialteknik)

Curriculum Approval

The curriculum was approved by the Faculty Board 2000-03-28 (Dnr F33/00)
Revised by the Faculty Board of Science and Technology Dnr FAK2 2008/187,
effective from 2008-10-30.

Revised by the Faculty Board of Health, Science and Technology 2015-07-01,
effective from date of decision.

General stipulations for third-cycle education are provided in the *Higher Education Act* and in the *Higher Education Ordinance*. The Licentiate/Doctoral programme is offered to the extent permitted by available funding.

1. General Information

Materials Engineering is a knowledge domain in which the properties and applications of different materials are described with regard to technically oriented engineering principally restricted to construction and functional materials and their applications. The connection between the microstructure and mechanical properties of materials and the technical application is treated.

There is established cooperation with other institutions of higher education at national and international levels. The technical application aspect means that there are also well-established industrial partnerships at the regional, national and international levels. At Karlstad University many disciplines participate in multidisciplinary research groups in or in related areas to materials science. Sharing research results and subject knowledge yielded through contract research projects is encouraged and constitutes an experience-based environment to the doctoral students.

Research in materials engineering is carried out in the form of theoretical and experimental studies, varying of basic character or industrially practice-related applications. Numerical modelling and advanced experimental equipment are important tools in doctoral studies. These are used for studying the structure of materials, mechanical and tribological properties, surface modification and the use of materials in engineering applications.

The doctoral programme is primarily designed for students with engineering qualifications. Career opportunities on completion may include expert or research leader in research and development at universities, research institutes or industry, teacher in higher education or other functions in industry.

The doctoral students participate in the cross-faculty mandatory doctoral courses. In accordance with Karlstad University's equal opportunities policy, gender issues are addressed. Doctoral students are also introduced to multi-disciplinary approaches and involved in interdisciplinary experiences.

2. Aims and Objectives

The general objectives of licentiate or doctoral studies in terms of knowledge and understanding, competence and skills, and judgement and approach are specified as follows in the *Higher Education Ordinance, Annex 2, SFS 2006:1053*):

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

- demonstrate the ability to identify and formulate issues with scholarly precision critically, independently 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 independently in research and development work and to work independently 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.*

Degree of Doctor

Knowledge and understanding

For a 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 a **Degree of Doctor** the third-cycle student shall

- *demonstrate the capacity for scholarly analysis and synthesis as well as to review and assess new and complex phenomena, issues and situations independently and critically*
- *demonstrate the ability to identify and formulate issues with scholarly precision critically, independently 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 a **Degree of Doctor** the third-cycle student shall

- *demonstrate intellectual independence 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 Objectives

The objectives of doctoral studies in Materials Engineering apply the general objectives stated above. The students shall also develop abilities to carry out research and project planning, disseminating information through articles in scientific and industry-related journals and oral presentations.

3. Admission Requirements

A person who meets the general admission requirements as well as the specific admission requirements and is judged to have the ability otherwise required for pursuing the programme successfully is eligible for admission.

3.1 General eligibility

A person who has earned a master's degree of at least 240 ECTS credits of which at least 60 ECTS cr are studies at master's level, or who in some other way in the country or abroad has acquired largely equivalent knowledge has general eligibility for admission. If there are special reasons for doing so, the faculty board may grant an individual applicant exemption from the general eligibility (Higher Education Ordinance, Ch.6).

3.2 Special eligibility

The special eligibility requirement for admission to doctoral studies in Materials Engineering is a Master's Degree with a major in materials engineering, or related fields such as materials science, physics and chemistry. Non-eligible applicants who have acquired equivalent knowledge in some other way may be deemed eligible.

4. Admission Procedure

Applications for admission to doctoral studies are processed in accordance with the procedures prescribed by the Board of Karlstad University

5. Selection

Candidates will be selected on the basis of their assessed capacity to successfully complete a programme at the doctoral level.

In the ranking and selection of the candidates, special attention will be paid to previous study records, with an emphasis on the quality of previously performed research or development work, especially at Master's level, previous research and development work and work experience of relevance to the doctoral programme, and the candidate's possibility to be present and partake in the departmental research environment.

6. Content and Outline

The doctoral programme can lead to a doctoral or licentiate degree. The licentiate degree requires two years of study, the equivalent of 120 ECTS cr. The doctoral degree requires four years of study, the equivalent of 240 ECTS cr. The studies include coursework and an independent project (licentiate thesis or doctoral thesis).

To earn a licentiate degree, the student is required to complete coursework of at least 30 ECTS credits and a thesis of at least 80 ECTS credits.

To earn a doctoral degree, the student is required to complete coursework of at least 60 ECTS credits and a thesis of at least 170 ECTS credits.

6.1 Courses

Cross-faculty courses:

For the Degree of Licentiate

- The History and Philosophy of Science, 7.5 ECTS credits (mandatory)

For the *Doctor's* degree:

- The History and Philosophy of Science, 7.5 ECTS credits (mandatory)
- Communicating Science, 4.5 ECTS credits (mandatory)

Subject-specific courses

In the individual study plan for each student the planned courses are stated. The courses are chosen with regard to the student's needs and research area. The courses include:

- Specialisation courses in materials engineering of at least 30 ECTS cr for the doctor's degree, and 15 ECTS cr for the licentiate degree.
- Elective subject or project specialisation courses in materials engineering or other subjects at Karlstad University, or other universities in Sweden or abroad.

Active participation in a progressive seminar series at a quarter, half, and three quarters of the total study period counts as max 3 ECTS cr. Students present and discuss, formulate and plan their research projects and follow up, report and discuss research results.

The students carry out a research project independently. The formulation and planning of the project is carried out and described in the individual study plan and can be presented and discussed in the mandatory seminar series. Students publish science articles and present papers at national and international conferences. The research project is often carried out in conjunction with several parties, e.g. university and industry partnership projects. The students discuss with and report to the supervisors and project group.

6.2 Licentiate and Doctoral Theses

Third-cycle students are required to write a thesis for a licentiate or a doctoral degree, which may be a monograph or a compilation thesis. In material engineering the students write a compilation thesis comprising an introductory part followed by several scientific articles publishable in international peer-reviewed journals. The licentiate thesis is to be defended at a licentiate seminar and the doctoral thesis at a public examination. Further information is provided in the policy documents Regulations on the Licentiate Thesis and Regulations on Doctoral Thesis and Public Defence Procedures. The thesis topic for either degree is chosen in consultation with the advisor and examiner. In materials engineering students write a compilation thesis in English with 4-6 articles for the doctor's degree and 3-4 articles for the licentiate degree.

6.3 Supervision

Admitted students are entitled to advisors in accordance with the principles stated in the current policy document at Karlstad University.

6.4 Individual Study Plan

At the start of the studies, the student shall draw up an individual study plan (ISP) in consultation with the advisors. The plan shall include a realistic estimate of time for course work, thesis work and supervision. The plan shall also include a project description and relevant ethical considerations.

The ISP is drawn up according to the form or system devised by the university.

The ISP is subject to continual revision (at least once a year) and shall be revised if changes in time or project plan are required.

Goal attainment in licentiate/doctoral studies shall be monitored on two occasions in the course of studies. After one year, an individual goal matrix is formulated and attached to the student's individual study plan.

One year before the preliminary date of licentiate degree completion and two years before the preliminary date doctoral degree completion the outcome of the individual goal matrix is evaluated when the ISP is followed up. If the evaluation indicates that the goal attainment is not satisfactory, the study plan is revised to ensure that the national requirements are met at the time of the final examination. The revised goal matrix is attached to the individual study plan.

6.5 Examination

Licentiate/doctoral students are examined in accordance with the requirements of each individual course syllabus. Doctoral or licentiate theses are examined in accordance with the *Higher Education Ordinance* (Ch.6, sections 33-35) and Karlstad University's current policy document.