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School of Engineering Sciences

## General syllabus for education at third-cycle level in the subject

This regulatory document has been decided by the President (v-2023-0326 3.2.2) pursuant to chapter 6 sections 26-27 of the Higher Education Ordinance. The regulatory document is valid with effect from 05-04-2017 and was last modified on 2023-06-13 (reference number V-2023-0325). The regulatory document regulates the main content of the education, requirements for special qualifications and the other regulations that are needed. The School of Engineering Sciences is responsible for review and questions about the governing document.

### 1 Content of the education

#### 1.1 The name of the subject in Swedish and in English translation

Matematik (Mathematics)

#### 1.2 Subject description

Mathematics is used in a wide range of areas in our society. The subject has its main focus on pure mathematics in the areas represented at KTH, such as algebra, algebraic geometry, algebraic topology, algorithms and complexity, analytical number theory, differential geometry, dynamical systems, combinatorics, complex and harmonic analysis, mathematical physics, partial differential equations, relativity, probability theory and spectral theory. The subject also includes applications such as image reconstruction and artificial intelligence.

#### 1.3 Specialisations

The subject has no specialisations.

#### 1.4 Organisation of the education

The programme is conducted under the guidance of a principal supervisor together with one or more assistant supervisors. An individual study plan (ISP) must be drawn up in consultation between the doctoral student and the principal supervisor. The doctoral student's progress is to be assessed at least once a year in connection with the revision of the individual study plan by the doctoral student and the principal supervisor. The established individual study plan (ISP) is revised annually and approved by the director of third-cycle education at the doctoral student's school. The ISP is a planning tool for students, and follow-up of the ISP is a tool for both KTH and the doctoral student to ensure study progress as planned, and to make any necessary changes to the undertakings of the doctoral student or KTH. The individual study plan is to be adapted to the student's background and the focus of the thesis.

Third-cycle courses and study programmes consist of a course component and a thesis component, with credit requirements as below.

#### 1.4.1 Activities for fulfilment of outcomes for the education according to the Higher Education Ordinance (HF)

Described below are activities for the doctoral student to achieve of the learning outcomes for third-cycle education according to the Higher Education Ordinance (HF) and the goals of KTH. The individual study plan specifies the activities for each individual doctoral student.

These are *general suggestions* on how the goals can be achieved. Also note that more *suggestions* can be found in the appendix (taken from the KTH template) at the end of this document. Students are encouraged to use these in the annual update of the ISP document.

##### *Learning outcomes: Knowledge and understanding*

For the Degree of Doctor the doctoral student shall:

- Demonstrate broad knowledge and a systematic understanding of the research field as well as advanced and up-to-date specialist knowledge in a limited area of this field.

Goal attainment is ensured, for example, by participating in graduate courses and reading and following relevant scientific literature. This outcome can be verified by, e.g., writing well-balanced introductions and background material to academic articles, conference contributions and doctoral-thesis introductions, and by being able to present and discuss one's own and others' research results at conferences and seminars.

- Demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.

Goal attainment is ensured, for example, by participating in relevant graduate courses and, in the thesis and academic articles, identifying and using methods relevant to the subject when solving research questions.

For a Degree of Licentiate, the doctoral 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 in particular.

Goal attainment is ensured, for example, by participating in graduate courses and reading and following the relevant academic literature, and by identifying and using methods relevant to the subject when solving research questions. This outcome can be verified by, e.g., writing well-balanced introductions and backgrounds to academic articles, conference contributions and licentiate-thesis introductions, and by being able to present and discuss one's own and others' research results at conferences and seminars.

##### *Learning outcome: 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.

Goal attainment is ensured, for example, by having identified previously unobserved phenomena and proposed new research questions, contributed a scientific explanation and drawn relevant conclusions in the academic articles and conference contributions authored by the doctoral student alone or with others.

- 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.

Goal attainment is ensured, for example, by critical review of prior work in the area, which is summarised in the academic articles authored by the doctoral student and in the doctoral thesis; and, based on this knowledge, solving the research questions posed through choice of appropriate methodology. The final assessment of this outcome is made by the examining committee at the public defence of the thesis.

- Demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research.

Goal attainment is ensured with a thesis that receives a passing grade from the examining committee.

- 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.

Goal attainment is ensured, for example, by presentations at academic conferences and/or presentations in an industrial or societal context, as well as by a thesis that is discussed at the defence and given a passing grade by a examining committee.

- Demonstrate the ability to identify the need for further knowledge.

Goal attainment is ensured, for example, by proposing new research. This is documented to some extent in academic articles and should be discussed in the thesis.

- 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.

Goal attainment is ensured, for example, by teaching in first- and second-cycle education or industry presentations, assisting in supervision of theses or transferring knowledge to potential industry partners.

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.

Goal attainment is ensured, for example, by critically reviewing prior work in the field, which is summarised in the academic articles authored by the doctoral student and in the licentiate thesis, by having proposed new research questions; and, based on this knowledge, solving the research questions posed through the choice of appropriate solution methodology.

- Demonstrate ability in both national and international contexts to present, discuss research, and research findings in speech and writing and in dialogue with the academic community and society in general.

Goal attainment is ensured, for example, by presentations at academic conferences and/or presentations in an industrial or societal context, and fulfilled and verified by a thesis discussed at a licentiate seminar and approved by the examiner.

- Demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.

Goal attainment is ensured, for example, by identifying the need for new knowledge, proposals for new research and by knowledge transfer to potential industrial partners. This is documented to some extent in academic articles and should be discussed in the thesis.

#### *Learning outcomes: Judgement and approach*

For the Degree of Doctor the doctoral student shall:

- Demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics.

Goal attainment is ensured with a passing grade in the course FSF3000 Ethics, Sustainability and Equity for Mathematicians, or its equivalent, and the assessment and discussion of ethics questions together with the supervisor in the choice and design of the research problem. The impact of research results on society at large should be discussed with the supervisor.

Intellectual independence is clarified by, among other things, the fact that the doctoral student's contributions are made explicit in the thesis. Scientific integrity is verified by, e.g., a mandatory plagiarism check of the thesis.

- 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.

Goal attainment is ensured by participation in and following discussions and debates in the academic environment, both locally (the departmental level) and in a wider context.

For a Degree of Licentiate, the doctoral student shall:

- Demonstrate the ability to make assessments of ethical aspects of his or her own research.

Goal attainment is ensured by assessing and discussing relevant ethical aspects with supervisors in the selection and design of research problems. The impact of research results on society at large should be discussed with the supervisor.

- Demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.

Goal attainment is ensured by participating in and following discussions and debates in the academic environment, both locally (the departmental level) and in a wider context.

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

Goal attainment is ensured, for example, by proposals for new research or participation in a doctoral course or workshop. This is documented to some extent in scientific articles and should be discussed in the thesis.

#### *KTH's outcome in sustainable development*

For both the Degree of Licentiate and the Degree of Doctor, the doctoral student shall:

- Demonstrate with knowledge and skills the ability to be able to contribute to sustainable societal development towards an equal, inclusive and climate-neutral society.

This outcome is considered achieved with a passing grade in the course Ethics, Sustainability and Equity for Mathematicians, or its equivalent, regarding sustainability and equity in society, as well as the assessment and discussion of sustainability and equity together with the supervisor in the choice and design of the research problem. The impact of research results on society at large should be discussed with the supervisor. For the licentiate degree, the course Ethics, Sustainability and Equity for Mathematicians does not need to be completed, but sub-components concerning sustainable development towards an equal, inclusive and climate-neutral society should be completed.

#### 1.4.2 Compulsory courses

FSF3000 Ethics, Sustainability and Equity for Mathematicians, 5 credits

#### 1.4.3 Recommended courses

The list of current graduate courses can be found on the Department's website under "Studies/Graduate Level", currently: <https://www.kth.se/math/studies/graduate/matematik>

The list of all established graduate courses can be found in the central KTH course and programme list, currently:

<https://www.kth.se/utbildning/forskarutbildning/kurser/org/SF>

#### 1.4.4 Conditional elective courses

The programme does not include any conditional elective courses.

#### 1.4.5 Requirements for the degree

##### **Degree of Doctor**

*A Degree of Doctor comprises 240 credits. At least 120 credits must consist of the doctoral thesis*

##### Thesis

*Quality requirements and possible other requirements for the thesis.*

Work on the doctoral thesis should begin as soon as possible upon starting the doctoral programme. A thesis topic must be chosen in consultation with the principal supervisor, and should be related to the research carried out in the departments concerned.

The thesis is a compulsory component of the doctoral degree. This component of the programme aims at students developing the ability to make independent contributions to research and engage in academic collaboration, both within and beyond their own subject. The thesis or licentiate thesis must include new research results that the student has developed, alone or in collaboration with others. The main scientific results must meet the quality requirements for publication in internationally recognised peer-reviewed journals. The doctoral student must make a distinct contribution to co-authored texts included in the thesis.

The thesis is normally to be written in English. It can either take the form of a compilation of academic articles or a monograph. In the former case, there must be a separate written summary. The scope of the thesis is discussed in consultation with the supervisor and usually includes three to five scientific articles in a compilation thesis. Regardless of whether the thesis is intended as a monograph or a compilation thesis, international publication of the achieved results should be sought during the doctoral period.

In cases where a doctoral thesis is based solely on work that has not yet been published or accepted for publication in peer-reviewed international academic journals, the director of third-cycle education should request prior opinions from the examining committee regarding the scientific depth of the work. This extra review of the thesis is in addition to the review by the supervisor and the mandatory advance reviewer.

## Courses

*The doctoral student shall have completed courses of at least 60 credits, of which 45 credits must be at third-cycle level and no more than 10 credits can be at first-cycle level.*

The doctoral student, in consultation with the principal supervisor, chooses the courses to be included in their study programme. The courses are designed to broaden and deepen their knowledge.

For a doctoral degree, at least 60 credits must be from courses in mathematics at the graduate level. Additional credits can be from second-cycle courses. Of the courses at the graduate level, at least 15 credits must be taken in each of the following areas

- algebra/combinatorics/number theory,
- analysis
- differential geometry/geometry/topology.

Deviations from the indicated credit totals may be made in exceptional circumstances.

## Degree of Licentiate

*A Degree of Licentiate comprises at least 120 credits. At least 60 credits must consist of the academic paper.*

## Thesis

*Quality requirements and possible other requirements for the licentiate thesis.*

Work on the licentiate thesis should begin as soon as possible upon starting the doctoral programme. A thesis topic must be chosen in consultation with the principal supervisor, and should be related to the research carried out in the departments concerned.

The licentiate thesis is a compulsory component of the licentiate degree. This component of the programme aims at students developing the ability to make independent contributions to research and engage in academic collaboration, both within and beyond their own subject. The licentiate thesis must include new research results that the student has developed, alone or in collaboration with others. The main scientific results must meet the quality requirements for publication in internationally recognised peer-reviewed journals. The student must make a distinct contribution to co-authored texts included in the thesis.

The thesis is normally to be written in English. It can either take the form of a compilation of academic articles or a monograph. In the former case, there must be a separate written summary. The scope of the licentiate thesis is discussed in consultation with the supervisor and usually includes three to five scientific articles. Regardless of whether the licentiate thesis is intended as a monograph or a compilation thesis, international publication of the achieved results should be sought during the doctoral period.

## Courses

*The doctoral student shall have completed courses of at least 30 credits, of which 15 credits must be at third-cycle level and no more than 10 credits can be at first-cycle level*

For a licentiate degree, at least 30 credits must be from courses in mathematics at the graduate level. Additional credits can be from second-cycle courses. Of courses at the graduate level, at least 7.5 credits must be taken in at least two of the following areas

- algebra/combinatorics/number theory,
- analysis
- differential geometry/geometry/topology.

### 1.4.6 Other elements in the education to promote and ensure goal fulfilment

Mid-term seminars are recommended for doctoral degrees in cases where a licentiate degree is not taken. Doctoral students and supervisors have a joint responsibility to evaluate and update the individual study plan, at least once a year, with the aim of achieving the qualitative targets.

## 2 Admission to education at third-cycle level (qualification etc.)

Admission to education at third-cycle level is regulated in Chapter 7, Section 40 of the Higher Education Ordinance and in the admission regulations at KTH. KTH's regulations on specific prerequisites and such abilities in other respects as are needed to assimilate the education in the relevant subject at the doctoral level are set out below.

### 2.1 Specific prerequisites

In order to be admitted to third-cycle education in **Mathematics**, the applicant must have knowledge of English equivalent to English 6.

### 2.2 Assessment criteria for testing the ability to assimilate the education

Selection is made from among the applicants who fulfil the entrance qualifications. The applicants' degree of maturity and capacity for independent judgement and critical analysis are important aspects of the selection process. Particular emphasis is placed on credits awarded in courses of a specialised nature or in the form of independent work such as the degree project.

The following assessment criteria apply for testing the ability to assimilate the education:

Selection for third-cycle education is based on assessed ability to assimilate such education. The ability assessment is primarily based on having passed courses and programmes that satisfy the entry requirements. Particular consideration is given to the following:

1. Knowledge and skills relevant for thesis work and the subject.  
These can be shown through attached documents and a possible interview
2. Assessed ability to work independently
  - a. ability to formulate and tackle scientific problems



- b. ability to communicate well in speech and writing
- c. maturity, judgement and ability to analyse critically and independently

The assessment may be based, for example, on degree projects and discussion of these at a possible interview.

- 3. Other experience relevant for third-cycle education, e.g. professional experience. These can be demonstrated through attached documents and, potentially, an interview.

### **3 Other regulations**

#### **3.1 Transitional regulations**

Doctoral students admitted under a previous programme syllabus have the right to switch to the most recently adopted and valid programme syllabus. Requests to change to a newer programme syllabus are made in writing to the director of third-cycle education. However, changing syllabi requires that the new syllabus can be completed in time. If no change of syllabus occurs, the doctoral student follows the programme syllabus under which they have been admitted.

## KTH Appendix: Goals for qualification and assessment criteria

Goals according to Appendix 2 of the Degree Ordinance to the Higher Education Ordinance, including requirements specified by KTH with examples of assessment criteria that can determine whether the doctoral student has achieved the goals. *The assessment criteria in the table are examples and developed as a support and inspiration for activity descriptions in part 1.4.*

### Degree of Doctor

Knowledge and understanding	
Intended learning outcomes	Assessment criteria with reference to numbering in eISP
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.	<p>The outcome has been achieved through the doctoral student having</p> <p><b>A1.1:</b> authored original scientific works where their own contributions are significant and identifiable. The works are of such quality that they have been published, or are expected to be published, in international scientific journals or conferences that apply peer review.</p> <p><b>A1.2:</b> demonstrated both broad and specialised knowledge in the research area by writing a thesis in which the research results were placed and discussed in a broader perspective, and presented a reference list of others' research results that spans the relevant breadth of the research area.</p> <p><b>A1.3:</b> demonstrated, at a seminar, a course or in the thesis or its public defence, a good ability to account for how their own research results relate to the research front within the research area, and justify how their own results advance this.</p> <p><b>A1.4:</b> actively participated in seminar activities where their own results were presented and discussed, as well as asked questions and provided feedback on other students' and researchers' presentations.</p>
Demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.	<p>The outcome has been achieved through the doctoral student having</p> <p><b>A2.1:</b> been examined with an approved result regarding intended learning outcomes in scientific methodology, which may be a course or equivalent learning element at third-cycle level.</p> <p><b>A2.2:</b> described basic theories in scientific theory and correctly applied one or more of these in their own research.</p> <p><b>A2.3:</b> practically applied to the research area appropriate methods and developed the ability to independently perform, interpret and critically examine the results in order to clarify whether the method and its execution were appropriate to obtain credible results that answer the scientific question.</p> <p><b>A2.4:</b> justified their choice of method and execution in relation to the issue and to alternative methods.</p> <p><b>A2.5:</b> described the advantages and disadvantages of different scientific methods used in their own research area, as well as the methods used in the broader definition of the research area</p>

<b>Competence and skills</b>	
<b>Intended learning outcomes</b>	<b>Assessment criteria with reference to numbering in eISP</b>
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.	<p>The outcome has been achieved through the doctoral student having</p> <p><b>B1.1:</b> demonstrated the ability to independently formulate and critically analyse both existing and new complex phenomena.</p> <p><b>B1.2:</b> presented concrete examples of scientific questions and problems of a complex nature from their own research and described how these were tested and how the results were analysed.</p> <p><b>B1.3:</b> described the interpretation of the results and how these were combined with existing knowledge to give rise to a new explanatory model.</p> <p><b>B1.4:</b> in cases where it is applicable, presented concrete examples of results that have given rise to falsification of a hypothesis and revision of the hypothesis.</p>
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.	<p>The goal has been achieved through the doctoral student having</p> <p><b>B2.1:</b> presented examples of independently performed experiments / simulations / tasks that were preceded by detailed time planning.</p> <p><b>B2.2:</b> in cases where it is applicable, presented examples of their own hypotheses that have been tested within the framework of their own research project and described the choice of method and outcome. In cases where the result did not turn out as expected, the research student shall have reported on possible sources of error and what measures were taken to move forward in the project.</p> <p><b>B2.3:</b> presented examples of and described and argued for the choice of methods for individual research tasks.</p> <p><b>B2.4:</b> described how it was ensured that the education could be completed on time and whether there were obstacles to staying within the time frame, as well as what measures were taken and their outcome.</p>
Demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research.	<p>The goal has been achieved through the doctoral student having</p> <p><b>B3.1:</b> authored original scientific works where their own contributions are significant and identifiable. The works are of such quality that they have been published, or are expected to be published, in international scientific journals or conferences that apply peer review.</p> <p><b>B3.2:</b> authored a thesis, based on the scientific work, of good scientific and linguistic quality that was authoritatively defended and discussed in a public defence of the doctoral thesis and been examined with a pass grade by an independent examining committee.</p>
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.	<p>The goal has been achieved through the doctoral student having</p> <p><b>B4.1:</b> in cases where it is applicable, participated in national and international conferences and presented their own research results in poster form or verbally, as well as participated in scientific discussions with other researchers in the research field.</p> <p><b>B4.2:</b> described how experience from conference or seminar presentations contributed to developing their own ability to</p>

	<p>communicate and defend scientific results, as well as how the presentations were received by other participants and whether valuable information could be obtained that helped their own studies progress.</p> <p><b>B4.3:</b> been examined with a pass grade for intended learning outcomes in communication or presentation technology in a suitable compulsory or optional course at third-cycle level.</p> <p><b>B4.4:</b> described basic concepts, tools and methods in presentation or communication technology, as well as demonstrated the ability to put the knowledge into practice by formulating different types of scientific presentation material of good quality.</p> <p><b>B4.5:</b> presented their research results in a pedagogical way for other students and researchers at academic seminars, for a general audience or for another category of recipients, where the formulation of presentation material and speech was based on pedagogical knowledge adapted to the audience's knowledge level and also answered questions at an adequate level for the audience.</p> <p><b>B4.6:</b> participated in outreach activities related to their own research in order to contribute to the dissemination of knowledge and exchange of knowledge with relevant stakeholder groups such as other universities, companies, authorities, schools etc.</p>
<p>Demonstrate the ability to identify the need for further knowledge.</p>	<p>The outcome has been achieved through the doctoral student having</p> <p><b>B5.1:</b> by means of concrete examples, described how the lack of essential knowledge needed to carry out a task was rectified and how this affected the possibility of carrying out the task. This may involve widely differing tasks and knowledge, with the proviso that the third-cycle students themselves must have realised that knowledge was lacking and handled this with measures relevant to the purpose.</p> <p><b>B5.2:</b> demonstrated insight that the knowledge front in higher education and research is in constant change and development and that definitive answers cannot always be obtained, as well as the ability to determine whether certain knowledge already exists, for example by means of thorough and critical examination of existing scientific literature.</p> <p><b>B5.3:</b> demonstrated the ability to question, evaluate and adapt their perception of their own level of knowledge and ability in relation to the prevailing knowledge front.</p>
<p>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.</p>	<p>The outcome has been achieved through the doctoral student having</p> <p><b>B6.1:</b> presented their research results in a pedagogical way for other students and researchers at academic seminars, for a general audience or for another category of recipients, where the formulation of presentation material and speech was based on pedagogical knowledge adapted to the audience's knowledge level and also answered questions at an adequate level for the audience.</p> <p><b>B6.2:</b> participated in outreach activities related to their own research in order to contribute to the dissemination of knowledge and exchange of knowledge with relevant stakeholder groups such as other universities, companies, authorities, schools etc.</p> <p><b>B6.3:</b> actively supervised other students in theoretical and / or practical projects. Third-cycle students should, with examples,</p>

	<p>account for and reflect on various aspects of their own input, for example how the supervision was structured, whether pedagogical methodology was applied, how it was ensured that the person who was supervised understood the instructions etc. Third-cycle students should also reflect on different roles of teachers and students and how personal dynamics and supervision techniques can affect the outcome of learning and interaction.</p> <p><b>B6.4:</b> been examined with a pass grade for intended learning outcomes in teaching and learning in higher education in a suitable compulsory or optional course at third-cycle level. The third-cycle student is thus assumed to be able to describe basic concepts, materials and methods, as well as conditions for teaching and learning in higher education, as well as to analyse, evaluate and develop teaching and learning. Third-cycle student is thus also assumed to be able to show the ability to evaluate and analyse different methods and approaches in higher education and to show the ability to take a student perspective into account.</p> <p><b>B6.5:</b> demonstrated the ability to collaborate and communicate in writing and speech, undertaken tasks and assignments that were planned and completed on time and demonstrated the ability to comply with applicable rules and directives and thereby acquired general knowledge and skills required in different societal functions.</p>
<b>Judgement and approach</b>	
<b>Intended learning outcomes</b>	<b>Assessment criteria with reference to numbering in eISP</b>
<p>Demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics.</p>	<p>The outcome has been achieved through the doctoral student having</p> <p><b>C1.1:</b> demonstrated intellectual integrity in the sense that their own choices and positions have been justified and defended on the basis of independent critical thinking in relation to proven experience and scientific basis.</p> <p><b>C1.2:</b> described how they ensured that their own scientific procedure in theory and practice was carried out in an honest and ethical manner.</p> <p><b>C1.3:</b> reflected on possible existing or hypothetical ethical dilemmas related to their own research area or to scientific research in general, and reported on their own ethically independent stance in the existing or hypothetical situation.</p> <p><b>C1.4:</b> been examined with a pass grade for intended learning outcomes in ethics in a suitable compulsory or optional course at third-cycle level. The research student is thus assumed to be able to describe basic theories in research ethics and relate these to their own approach and research work.</p>
<p>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</p>	<p>The outcome has been achieved through the doctoral student having</p> <p><b>C2.1:</b> presented concrete examples of how their own research results, and the research area in general, can contribute new knowledge to the research front in the area and justify its societal relevance.</p> <p><b>C2.2:</b> critically reflected on limitations of their own research results, and the research area in general, in order to contribute to solving</p>

	<p>societally relevant problems, as well as identify possible situations where their own research results can be used in both a positive and negative way.</p> <p><b>C2.3:</b> demonstrated good ability to reflect on how their own research results can contribute to sustainable societal development and can, where relevant, also link these to the prioritised global sustainable development goals.</p> <p><b>C2.4:</b> described how their own actions and approach take into account the concept of sustainability.</p> <p><b>C2.5:</b> been examined with a pass grade for intended learning outcomes in sustainable development in a suitable compulsory or optional course at third-cycle level. The research student is thus assumed to be able to describe basic theories in sustainability and relate these to their own approach and research work.</p>
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## Degree of Licentiate

Knowledge and understanding	
Intended learning outcomes	Assessment criteria with reference to numbering in eISP
<p>Demonstrate knowledge and understanding in the field of research including current specialist knowledge in his or her artistic field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular..</p> <p><i>Main differences in relation to the doctoral degree: For the licentiate degree, it is enough to be able to show “knowledge and understanding”, as opposed to “broad and systematic understanding”. Also, “deep up-to-date specialist knowledge” is replaced by “up-to-date specialist knowledge”.</i></p>	<p>The outcome has been achieved through the doctoral student having</p> <p><b>A1.1:</b> authored original scientific works where their own contributions are significant and identifiable. The works are of such quality that they have been published, or are expected to be published, in international scientific journals or conferences that apply peer review.</p> <p><b>A1.2:</b> demonstrated both broad and specialised knowledge in the research area by writing a licentiate thesis in which the research results were placed and discussed in a broader perspective, and presented a reference list of others’ research results that spans the relevant breadth of the research area.</p> <p><b>A1.3:</b> demonstrated, at a seminar, a course or in the licentiate thesis and its public defence, a good ability to account for how their own research results relate to the research front within the research area, and justify how their own results advance this.</p> <p><b>A1.4:</b> actively participated in seminar activities where their own results were presented and discussed, as well as asked questions and provided feedback on other students’ and researchers’ presentations.</p>
Competence and skills	
Intended learning outcomes	Assessment criteria with reference to numbering in eISP
<p>Demonstrate the ability to identify and formulate issues with scholarly precision</p>	<p>The goal has been achieved through the doctoral student having</p>

<p>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</p> <p><i>Main differences in relation to the doctoral degree: For the licentiate degree, it is emphasized that this is “limited research work” that will contribute to the development of knowledge, in contrast to the doctoral degree where one must be able to show the ability to “conduct research”.</i></p>	<p><b>B1.1:</b> demonstrated the ability to independently formulate and critically analyse both existing and new complex phenomena.</p> <p><b>B1.2:</b> presented examples of their own questions that were tested within the framework of their own research project, as well as described the choice of method and outcome. In cases where the result did not turn out as expected, the research student shall have reported on possible sources of error and what measures were taken to move forward in the project.</p> <p><b>B1.3:</b> presented examples of independently performed experiments / simulations / tasks that were preceded by detailed time planning.</p> <p><b>B1.4:</b> presented examples of and described and argued for the choice of methods for individual experiments.</p> <p><b>B1.5:</b> described how it was ensured that the education could be completed on time and whether there were obstacles to staying within the time frame, as well as what measures were taken and their outcome.</p>
<p>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.</p> <p><i>Main differences in relation to the doctoral degree: The licentiate degree requires the student to communicate their research “clearly”, as opposed to communicating “with authority”.</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p><b>B2.1:</b> in cases where it is applicable, participated in national and international conferences and presented their own research results in poster form or verbally, as well as participated in scientific discussions with other researchers in the research field.</p> <p><b>B2.2:</b> described how experience from conference or seminar presentations contributed to developing their own ability to communicate and defend scientific results, as well as how the presentations were received by other participants and whether valuable information could be obtained that helped their own studies progress.</p> <p><b>B2.3:</b> been examined with a pass grade for intended learning outcomes in communication or presentation technology in a suitable compulsory or optional course at third-cycle level.</p> <p><b>B2.4:</b> described basic concepts, tools and methods in presentation or communication technology, as well as demonstrated the ability to put the knowledge into practice by formulating different types of scientific presentation material of good quality.</p> <p><b>B2.5:</b> presented their research results in a pedagogical way for other students and researchers at academic seminars, for a general audience or for another category of recipients, where the formulation of presentation material and speech was based on pedagogical knowledge adapted to the audience’s knowledge level and also answered questions at an adequate level for the audience.</p> <p><b>B2.6:</b> participated in outreach activities related to their own research in order to contribute to the dissemination of knowledge and exchange of knowledge with relevant stakeholder groups such as other universities, companies, authorities, schools etc.</p>
<p>Demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity..</p> <p><i>Main differences in relation to the doctoral degree: The doctoral student's future contribution to society through research and</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p><b>B3.1:</b> authored original scientific works where their own contributions are significant and identifiable. The works are of such quality that they have been published, or are expected to be published, in international scientific journals or conferences that apply peer review.</p> <p><b>B3.2:</b> authored a licentiate thesis based on their own studies of good</p>

<p>education is toned down and the focus is on the doctoral student being able to work on activities that require skills in research work but not a doctoral degree.</p>	<p>scientific and linguistic quality that have been defended and discussed at a licentiate seminar and examined and given a pass grade by an independent examiner.</p>
<p><b>Judgement and approach</b></p>	
<p><b>Intended learning outcomes</b></p>	<p><b>Assessment criteria with reference to numbering in eISP</b></p>
<p>Demonstrate the ability to make assessments of ethical aspects of his or her own research.</p> <p><i>Main differences in relation to the doctoral degree: The ability to make ethical research assessments is limited to their own research and not in general.</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p><b>C1.1:</b> demonstrated intellectual integrity in the sense that their own choices and positions have been justified and defended on the basis of independent critical thinking in relation to proven experience and scientific basis.</p> <p><b>C1.2:</b> described how they ensured that their own scientific procedure in theory and practice was carried out in an honest and ethical manner.</p> <p><b>C1.3:</b> reflected on possible existing or hypothetical ethical dilemmas related to their own research area or to scientific research in general, and reported on their own ethically independent stance in the existing or hypothetical situation.</p> <p><b>C1.4:</b> been examined with a pass grade for intended learning outcomes in ethics in a suitable compulsory or optional course at third-cycle level. The research student is thus assumed to be able to describe basic theories in research ethics and relate these to their own approach and research work.</p>
<p>Demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.</p> <p><i>Main differences in relation to the doctoral degree: For the licentiate degree, only “insight” is required, as opposed to “in-depth insight” for the doctoral degree.</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p><b>C2.1:</b> presented concrete examples of how their own research results, and the research area in general, can contribute new knowledge to the research front in the area and justify its societal relevance.</p> <p><b>C2.2:</b> critically reflected on limitations of their own research results, and the research area in general, in order to contribute to solving societally relevant problems, as well as identify possible situations where their own research results can be used in both a positive and negative way.</p> <p><b>C2.3:</b> demonstrated good ability to reflect on how their own research results can contribute to sustainable societal development and can, where relevant, also link these to the prioritised global sustainable development goals.</p> <p><b>C2.4:</b> described how their own actions and approach take into account the concept of sustainability.</p>
<p>Demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.</p> <p><i>Main differences in relation to the doctoral degree: The same requirement to be able to identify the need for additional knowledge with the addition of being able to take responsibility for their own knowledge</i></p>	<p><b>C3.1:</b> by means of concrete examples, described how the lack of essential knowledge needed to carry out a task was rectified and how this affected the possibility of carrying out the task. This may involve widely differing tasks and knowledge, with the proviso that the third-cycle students themselves must have realised that knowledge was lacking and handled this with measures relevant to the purpose.</p> <p><b>C3.2:</b> demonstrated insight that the knowledge front in higher education and research is in constant change and development and</p>



*development, which may be considered to be implied for a doctoral degree.*

that definitive answers cannot always be obtained, as well as the ability to determine whether certain knowledge already exists, for example by means of thorough and critical examination of existing scientific literature.

**C3.3:** demonstrated the ability to question, evaluate and adapt their perception of their own level of knowledge and ability in relation to the prevailing knowledge front.