General syllabus for third-cycle studies in the subject Energy Technology

1 This governance document was adopted by the Faculty Board of the School of Industrial Engineering and Management (registration number M-2024-0018) with reference to Chapter 6, Sections 26–27 of the Higher Education Ordinance. This governance document is in force as of 9 December 2024. This governance document regulates the main content of the programme, specific entry requirements, and other necessary regulations. The Faculty Board of the School of Industrial Engineering and Management is responsible for reviewing the governance document and answering questions about it.

2 Programme content

2.1 The name of the subject in Swedish and English

Swedish: Energiteknik English: Energy Technology

2.2 Description of the subject

Energy technology encompasses virtually all types of energy conversion and transport in various devices and systems.

The Department of Energy Technology covers both fundamental areas such as thermodynamics and heat transfer, and applied areas such as heat pumps, indoor climate, district heating, district cooling, renewable energy, boilers, nuclear reactors, turbines, cooling of electronics, nuclear safety, energy conservation and environmental issues, to name but a few.

Research is conducted in various contexts within energy conversion, power production, and the distribution and use of energy. Today, there are high demands on energy technology solutions to be resource-efficient and sustainable from an environmental, technical, economic, and societal perspective.

These demands are expected to increase significantly in the future, which is why great importance is attached to education that promotes the ability to think holistically and systemically, as well as creative and IT-supported problem solving, often in broader interdisciplinary contexts.

Third-cycle education includes:

- Technical and socio-economic studies of energy systems at both a broad (international, national) and local level.

- Methods, systems and components for energy conversion – not only from primary energy to work, electricity and heat, but also from work, electricity and heat to the goods and services demanded by society.

- Physical phenomena that govern these energy conversion processes.

- Methods for limiting the environmental impact of energy conversion processes. These include the utilisation of “flowing energy sources” (sun, wind, water) and methods for increasing the efficiency of energy use.

2.3 Specialisation(s)

This subject has no specialisations.

2.4 Organisation of the programme

2.4.1 Activities for achieving the intended learning outcomes of the programme according to the Higher Education Ordinance

The activities required for the doctoral student to achieve the intended learning outcomes for the award of third-cycle qualification pursuant to the Higher Education Ordinance and KTH's objectives are described below. The activities for each individual doctoral student are specified in the individual study plan.

Outcomes: Knowledge and understanding

For the Degree of Doctor, the doctoral 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.

This outcome can be achieved by the doctoral student continuously training and developing their ability to plan and conduct their own research; acquiring both broad and specialised knowledge from scientific literature relevant to the research area; actively presenting their own research results in the form of scientific publications and at national and international conferences, seminars or workshops; taking courses that build on knowledge from previous programmes and provide both broad and deep understanding of the research area, including seminar courses in which the research work of other doctoral students and researchers is critically reviewed, analysed and discussed; and writing and defending a doctoral thesis.

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

This outcome can be achieved by the doctoral student continuously training and developing their ability to plan and conduct their own research; acquiring knowledge from scientific literature relevant to the research area; actively presenting their own research results in the form of scientific publications and at national and international conferences, seminars or workshops; taking courses relevant to the research area, including seminar courses in which the research work of other doctoral students and researchers is critically reviewed, analysed and discussed; and writing and defending a licentiate thesis. This outcome can be achieved by the doctoral student continuously training and developing their ability to identify, motivate and analyse relevant research questions and the choice of appropriate methods; acquiring knowledge and thoroughly and critically reviewing scientific papers in their own research area; using different methods in their research in practice; taking and being assessed in courses and participating in workshops and scientific seminars with a methodological focus relevant to the

subject and research area; and taking courses in subjects such as scientific and research methodology.

For the 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 of research in particular.

This outcome can be achieved by the doctoral student continuously training and developing their ability to plan and conduct their own research; acquiring knowledge from scientific literature relevant to the research area; actively presenting their own research results in the form of scientific publications and at national and international conferences, seminars or workshops; taking courses relevant to the research area, including seminar courses in which the research work of other doctoral students and researchers is critically reviewed, analysed and discussed; and writing and defending a licentiate thesis.

Outcomes: Competence and skills

For the Degree of Doctor, the doctoral student shall:

- Demonstrate the capacity for scientific analysis and synthesis as well as to review and assess new and complex phenomena, issues and situations autonomously and critically.

This outcome can be achieved by the doctoral student continuously training and developing their ability to independently interpret, analyse, discuss and synthesise research results; actively reflecting on possible sources of error and alternative approaches for handling complex research questions; carrying out interdisciplinary activities and reasoning interdisciplinarily; independently evaluating reasons why experiments have not yielded expected results and, based on these insights, proposing new ways of advancing the research or the research question; and testing scientific hypotheses.

- Demonstrate the ability to identify and formulate issues with scientific 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.

This outcome can be achieved by the doctoral student continuously practising and developing their ability to independently plan and carry out relevant studies and experiments with clear objectives in a valid manner and within timeframes appropriate to the task; formulating new research questions, hypotheses and approaches to be answered and tested based on existing literature, their own experience and reflection on their own results; and summarising their own results and relating them to the published results of others.

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

This outcome is achieved by the doctoral student having independently planned and carried out experimental or theoretical studies on a sound and proven scientific basis and using scientific research methodology relevant to the third-cycle subject; analysed and critically reviewed their own results and compiled them in written form in the form of articles published in peer-reviewed international scientific journals or in the form of manuscripts of sufficiently good

quality that they can be assumed to be published in peer-reviewed international scientific journals; summarised their own research results in a doctoral thesis, where these are also placed in relation to existing knowledge in the research area; and meritoriously defended and discussed the results at a public defence.

- 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 scientific community and society in general.

This outcome can be achieved by the doctoral student continuously training and developing their ability to take responsibility for writing scientific papers; presenting their research results to both experts in the field and to a wider audience; relating their own research results to the current state of knowledge in the research area and the industry in which the results can be applied; presenting their own research results with authority and in a pedagogical manner to other researchers and students at academic seminars; and being assessed in courses in which presentation and discussion of their own research results are compulsory elements.

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

This outcome can be achieved by the doctoral student continuously training and developing the ability to stay informed and updated on national and international developments in their own research field and neighbouring fields; critically reflecting on how their own theoretical and methodological approaches relate to the overall knowledge base and the research front and whether their own knowledge and methodology are adequate or need to be developed; identifying and formulating questions that would be justified to investigate in order to further develop their own research project from a basic or applied research perspective, and which methods are suitable for the purpose; and developing the ability to adapt their own perceptions based on the acquisition of new knowledge.

- 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.

This outcome can be achieved by the doctoral student continuously practising and developing their ability to identify issues that can benefit society; communicating their own research results in writing and presenting to, and discussing with, other researchers at academic seminars and seminar courses; collaborating with other researchers and interacting with actors within and outside academia; pedagogically teaching and supervising students at the first- and second-cycle level after having successfully completed a compulsory course in higher education pedagogy at the third-cycle level; and presenting their own research results to the wider community, e.g. in industry journals, at meetings with industry actors, in popular science journals, or to compulsory or upper-secondary school pupils.

For the Degree of Licentiate, the doctoral student shall:

- Demonstrate the ability to identify and formulate issues with scientific 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.

This outcome can be achieved by the doctoral student continuously practising and developing their ability to independently plan and carry out limited research tasks with clear objectives

within timeframes appropriate to the task; formulating research questions, hypotheses and approaches to be answered and tested based on existing literature, their own experience of and reflection on their own results; and summarising their own results and relating them to the published results of others.

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

This outcome can be achieved by the doctoral student continuously training and developing their ability to take responsibility for writing scientific papers; presenting their research results to researchers in the research area; relating their own research results to the current state of knowledge in the research area and the industry in which the results can be applied; presenting their own research results in a pedagogical manner to other researchers and students at academic seminars; and being assessed in courses in which presentation and discussion of their own research results are compulsory elements.

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

This outcome can be achieved by the doctoral student continuously training and developing their ability to communicate their own research results in writing in the form of scientific publications and a licentiate thesis; pedagogically presenting to and discussing with other researchers within or outside academia; discussing and critically reviewing their own and others' research results within the framework of compulsory seminar courses; and taking a compulsory course in higher education pedagogy at the third-cycle level.

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.
  This outcome only applies for the Degree of Doctor.

This outcome can be achieved through assessment in a subject course in research ethics or other courses with individual learning outcomes in ethics that contribute to progression towards goal attainment. Progression towards this outcome is also achieved by the doctoral student continuously training and developing their ability to independently formulate and critically review their own and others' research; performing research tasks in an honest and ethical manner; making ethical judgements by reflecting on and dealing with any ethical dilemmas that may arise in their own research area and in research in general; and demonstrating intellectual integrity by critically justifying and defending their own positions based on proven experience and a scientific foundation.

- 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.

This outcome can be achieved by the doctoral student continuously training and developing their ability to deeply reflect on both expected and unexpected results and handle the results adequately; reflecting on opportunities and limitations within their own research project; and reflecting on the opportunities and limitations of their own research in a broader social science perspective.

For the Degree of Licentiate, the doctoral student shall:

- Demonstrate the ability to make assessments of ethical aspects of their own research.

This outcome can be achieved through assessment in a subject course in research ethics or other courses with individual learning outcomes in ethics that contribute to progression towards goal attainment. Progression towards this outcome is also achieved by the doctoral student continuously training and developing their ability to independently formulate and critically review their own research results; performing research tasks in an honest and ethical manner; and making research ethics assessments by reflecting on and dealing with issues that may arise in their own research and its execution.

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

This outcome can be achieved by the doctoral student continuously training and developing their ability to reflect on both expected and unexpected results and handle the results adequately; reflecting on opportunities and limitations within their own research project; and reflecting on the opportunities and limitations of their own research in a broader social science perspective.

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

This outcome can be achieved by the doctoral student continuously training and developing the ability to stay informed and updated on national and international developments in their own research field and neighbouring fields; critically reflecting on how their own theoretical and methodological approaches relate to the overall knowledge base and the research front and whether their own knowledge and methodology are adequate or need to be developed; identifying and formulating questions that would be justified to investigate in order to further develop their own research project from a basic or applied research perspective, and which methods are suitable for the purpose; and developing the ability to adapt their own perceptions based on the acquisition of new knowledge.

KTH's intended learning outcomes in sustainable development

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

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

This outcome can be achieved through assessment in a subject course in sustainable development at the third-cycle level. Other courses with individual learning outcomes in sustainable development can also contribute to further progression towards goal attainment. This outcome also includes education on gender equality, diversity and equal opportunities, and climate-neutral and climate-improving societal development. As further progression towards the outcome, the doctoral student should continuously train and develop their ability to account for their own research, behaviour and approach; take into account its direct or indirect economic, social or environmental consequences and impact on the immediate or distant environment; and take the initiative to acquire knowledge and reflect on sustainable development in a broader global perspective.

2.4.2 Compulsory courses

To promote the attainment of the qualitative targets, doctoral students are required to complete compulsory components, whether they are pursuing a Degree of Doctor or a Degree of Licentiate.

The current range of courses offered is continuously evolving and may therefore vary over time. The school undertakes to compile and provide up-to-date information on courses and other course activities organised within the school, and to provide information on suitable courses and course activities outside the school and the university, if necessary.

An introductory course to research for doctoral students relevant to researching students in third-cycle programmes at the School of Industrial Engineering and Management, ITM, at the Royal Institute of Technology, KTH (*FLF3019 Introduction to Research Studies at the School of Industrial Engineering and Management, 6.0 credits or equivalent)*. The course should explain the relevant procedures and processes for the doctoral programmes, with the responsibilities and roles of doctoral students and supervisors clearly set out. The course orients doctoral students to the different types of research conducted at the various departments (or equivalent) of ITM and gives them basic insight into the different scientific perspectives and research methods used. Through active participation, doctoral students acquire basic knowledge of and skills in reviewing, writing, publishing and communicating science. The course also addresses sustainability, gender equality, diversity and research ethics in relation to doctoral studies. Finally, the course gives the doctoral students the opportunity to present and discuss their own thesis work, with particular emphasis on research design and overall thesis planning.

In addition to this course, a mid-way seminar is compulsory for those pursuing a Degree of Doctor, as set out in KTH's general guidelines for third-cycle education.

2.4.3 Recommended courses

Recommended courses include established third-cycle courses in the third-cycle subject with a relevant research focus, courses in research methodology, presentation techniques, academic writing and communication, and literature surveys. Examples of relevant courses are found below. Doctoral students should also actively seek out and propose suitable learning activities that, in addition to the compulsory courses, aim at further progression towards the qualitative

targets and supplementation of the necessary knowledge, and consult with their supervisor and the director of third cycle education or programme director about the suitability of the proposed course activities.

1. FMJ3122 Research Seminars, 4.5 credits
2. FMJ3123 Literature Survey, 6.0 credits

Note that for FMJ3123 to be included as a course in the programme, the literature survey must be significantly more extensive than that normally included in the thesis. The purpose is for the student to acquire peripheral knowledge and to become aware of research in related research areas, not only directly related to the research. The submitted material for FMJ3123, or equivalent course, must therefore include both the comprehensive literature survey and the literature survey from the thesis. This procedure also ensures that course credits are not counted double.

2.4.4 Conditionally elective courses

The general syllabus for the third-cycle subject does not specify any conditionally elective courses. For courses that are not established or given at KTH, the following conditions apply: Non-established courses can be included in the third-cycle qualification. However, all courses and course activities not established by a Swedish university must be validated by the programme's director of third cycle education or programme director before they can be included in the course requirements of the individual study plan and the third-cycle qualification.

Online distance courses can be included in the individual study plan provided that their quality can be demonstrated by the doctoral student and supervisor with the documentation necessary for validation. The scope, level and examination must be documented in the manner prescribed by general and local regulations. Any decision regarding the transfer of credits is made by the director of third cycle education/programme director.

2.4.5 Qualification requirements

Degree of Doctor

The Degree of Doctor comprises 240 credits. The thesis shall comprise at least 120 credits.

For a Degree of Doctor within the subject, a thesis comprising 180 credits is normally required.

Thesis

Quality requirements and any other requirements for the thesis.

Compilation thesis

The thesis should be based on research results of such quality that they are, or can be expected to be, published in peer-reviewed scientific journals. A doctoral thesis in the subject normally comprises 180 credits (three years of full-time studies) and has a scope corresponding to four scientific articles, with the doctoral student being the first author of at least two articles, at least one of which is accepted for publication in a peer-reviewed journal. However, the number of articles may vary depending on the scope, scientific level and dignity, as well as the doctoral student's contribution to the respective work. The doctoral student must describe their contribution to each article in the thesis.

KTH's guidelines for third-cycle education specify, as a compulsory requirement, that a doctoral thesis must be reviewed by both the principal supervisor and a formally appointed quality reviewer. At the time of the quality review, the thesis must be in a fully completed state, where the principal supervisor has already performed a significant review. If the quality reviewer does not consider the thesis to be ready, a detailed account of the reason must be attached to the statement.

Monograph thesis

A doctoral thesis can also be written as a monograph, which is a relatively comprehensive and coherent scientific text. Previous publications may be appended to a monograph. Monographs should generally be avoided. In cases where a monograph is considered applicable, its content should be of such a scientific level that all or most of its content can be considered to fulfil the requirements for publication in peer-reviewed scientific journals of good international quality.

A monograph shall undergo advance review by the principal supervisor and a formally appointed quality reviewer. At the time of the quality review, the thesis must be in a fully completed state, where the principal supervisor has already performed a significant review. If the quality reviewer does not consider the thesis to be ready, a detailed account of the reason must be attached to the statement.

Courses

The doctoral student must have completed courses totalling at least 60 credits, of which at least 45 credits must be at the third-cycle level and a maximum of 10 credits may be at the first-cycle level.

For the Degree of Doctor in the third-cycle subject, the course requirements normally total 60 credits (one year of full-time studies), with at least 45 of these credits at the third-cycle level and maximum 15 credits at the second-cycle level.

Degree of Licentiate

The Degree of Licentiate comprises at least 120 credits. The licentiate thesis shall comprise at least 60 credits.

For a Degree of Licentiate within the subject, a thesis comprising 90 credits is normally required.

Licentiate thesis

Quality requirements and any other requirements for the licentiate thesis.

The licentiate thesis should be based on research results of such quality that they are, or can be expected to be, published in peer-reviewed scientific journals. A licentiate thesis in the subject normally comprises 90 credits (one and a half years of full-time studies) and has a scope corresponding to two scientific articles, with the doctoral student being the first article of at least one article, and at least one accepted for publication in a peer-reviewed journal. However, the number of articles may vary depending on the scope, scientific level and dignity, as well as the doctoral student's contribution to the respective work.

A licentiate thesis can also be written as a monograph, which is a relatively comprehensive and coherent scientific text. Previous publications may be appended to a monograph. Monographs should generally be avoided. In cases where a monograph is considered applicable, its content

should be of such a scientific level that all or most of its content can be considered to fulfil the requirements for publication in peer-reviewed scientific journals of good international quality.

KTH's guidelines for third-cycle education specify that a licentiate thesis must be reviewed by both the principal supervisor and a formally appointed advance reviewer. At the time of the advance review, the thesis must be in a fully completed state, where the principal supervisor has already performed a significant review.

Courses

The doctoral student must have completed courses totalling at least 30 credits, of which at least 15 credits must be at the third-cycle level and a maximum of 10 credits may be at the first-cycle level.

For the Degree of Licentiate in the third-cycle subject, the course requirements normally total 30 credits (one half year of full-time studies), with at least 15 of these credits at the third-cycle level.

2.4.6 Other elements of the programme to promote and ensure goal attainment

Follow-up of the individual study plan.

It is compulsory for supervisors and doctoral students to jointly follow up the individual study plan regularly and at least once a year. The individual study plan shall be designed to ensure that the qualitative targets of the Higher Education Ordinance and KTH's objectives can be achieved within the specified time. The general syllabus shall be used as support when designing and following up on the individual study plan. Progression towards goal attainment shall be evaluated by the supervisor and doctoral student at the compulsory follow-up of the individual study plan. The doctoral student shall reflect on, exemplify and justify how completed and ongoing study activities have promoted progression since the last follow-up. Justification of the progression shall be made in writing in the dedicated section of the electronic individual study plan, preferably by the doctoral student him/herself. All elements of the programme, thesis work, courses, workshops, conferences, outreach activities, etc. shall be taken into account.

The choice of courses and learning activities that are not compulsory is agreed between the doctoral student and the supervisor. At the annual follow-up, planned courses and learning activities are added to the individual study plan for the coming year.

Mid-way seminar

The seminar is compulsory and is held after half the period of study. Third-cycle studies resulting in a Degree of Doctor comprise 48 months of full-time studies (100% activity) if departmental duties amount to 0%, or 60 months of study (80% activity) if departmental duties amount to 20%. Third-cycle studies resulting in a Degree of Licentiate comprise 24 months of full-time studies (100% activity) if departmental duties amount to 0%, or 30 months of study (80% activity) if departmental duties amount to 20%. The estimated time point of the mid-way seminar for a Degree of Doctor as the qualitative target is 24–30 months. The estimated time point of the mid-way seminar for a Degree of Licentiate as the qualitative target is 12–15 months. The lower and upper time limits refer to studies with departmental duties of 0% and 20%, respectively. Please note that the percentage of departmental duties may not exceed 20%. In addition to the seminar, where the doctoral student presents their research results, completed courses and other activities carried out to achieve the qualitative targets, the doctoral student writes a brief report on the results achieved. At least two evaluators read the report, participate in the seminar and provide feedback to the doctoral student and supervisor. The

evaluators must be supervisors who are not involved in the doctoral student's normal supervision. In addition to the academic outcome, the evaluators shall also consider the fulfilment of courses completed and assessed, where it can be expected that approximately 50% of the required course credits have been completed and passed.

Details for how the mid-way seminar will be conducted are provided by the third-cycle programme's director of studies.

Scientific exchange and communication

The doctoral student shall actively participate in scientific exchange by presenting their own research results at international conferences, major national conferences, workshops, summer schools or events organised by companies. In this context, active participation refers to a scientific lecture, an oral presentation in pitch format, or a poster presentation to a scientific audience. It is a good idea to use the recommended course for this purpose (FMJ3123).

Interim seminars

It is strongly recommended that doctoral students pursuing a Degree of Doctor also present their research results and achieved objectives in interim seminars. An interim seminar is a seminar event held halfway between the start and the mid-way seminar (30% seminar) as well as halfway between the mid-way seminar and completion of third-cycle studies (80% seminar). The form of the interim seminar is decided jointly by the doctoral student and their supervisor, but should include checking progression towards qualitative targets (including courses). It should also be open to, as a minimum, the student's own department, and end with a brief written report based on the template, describing the progression towards achieved objectives being sent to the third-cycle programme administrator for archiving. In order to maximise the use of resources, these seminars can be coordinated at the programme level and coordinated with any upcoming mid-ways seminars (for other doctoral students). These two seminars can be part of the recommended course (FMJ3122).

3 Admission to third-cycle programmes (entry requirements, etc.)

Admission to third-cycle programmes is regulated in Chapter 7, Section 40 of the Higher Education Ordinance and in KTH's admission regulations. KTH's regulations on specific entry requirements and other abilities needed to benefit from the third-cycle programme in the subject in question are set out below.

3.1 Specific entry requirements

To be admitted to a third-cycle programme in Energy Technology, the applicant must have passed at least 60 credits worth of courses at no lower than the second-cycle level in the subject Energy Technology or other subjects deemed directly relevant to the specialisation in question. These requirements are also deemed to be met by those who have acquired essentially equivalent knowledge in other ways.

To be admitted to a third-cycle programme in Energy Technology, the applicant must have English proficiency equivalent to English 6.

The programme is primarily aimed at the recruitment of individuals with a Swedish or foreign Master of Science in Engineering specialised in energy technology (or equivalent). Due to the interdisciplinary nature of the programme, students from other technical or non-technical backgrounds may be considered for certain projects.

3.2 Criteria for assessing the ability to succeed in the programme

When assessing the ability to succeed in the programme, the following assessment criteria are used:

Admission to a third-cycle programme is based on assessed ability to succeed in the programme. The assessment of ability is primarily based on qualifying education. The following are given special consideration:

1. Knowledge and skills relevant to the thesis work and the subject.
   These can be demonstrated through attached documents and an interview, if applicable.
2. Assessed ability to work autonomously
   a. ability to formulate and address scientific problems
   b. written and oral communication skills
   c. maturity, judgement and capacity for independent critical analysis

   The assessment can, for example, be based on the degree project and a discussion of this at a possible interview.
3. Other experience relevant to the third-cycle programme, such as professional experience.

4 Other necessary regulations

Applicants with foreign education

When assessing applicants with foreign higher education qualifications, the study courses and programmes that meet the general entry requirements for admission to a third-cycle programme in the country in question should in most cases also meet the general entry requirements for admission to a third-cycle programme at KTH. In cases where the education system differs significantly from Sweden's, or where there is uncertainty about the quality of the education system, the Admissions Committee for Higher Education Studies and/or KTH should be contacted. Knowledge of factors such as the university or college at which the applicant received their first-cycle and second-cycle education is of great importance in determining equivalence.

4.1 Transitional provisions

Doctoral students who were admitted under a previous syllabus are entitled to follow either the new syllabus or the syllabus under which they were admitted. Requests to follow the previous syllabus or requests to follow the new syllabus are to be made to the director of third cycle education, via the director of studies for the third-cycle programme. However, in order to switch the general syllabus, the student must be able to prove that the requirements of the new syllabus can be achieved by the deadline.

Appendix: Qualitative targets and assessment criteria

Intended learning outcomes pursuant to the System of Qualification, Annex 2 to the Higher Education Ordinance, plus requirements specified by KTH, with examples of assessment criteria that can determine whether the doctoral student has achieved the outcome in question. *The assessment criteria in the table are examples and were developed as support and inspiration for activities described in Section 1.4.*

Degree of Doctor

Knowledge and understanding	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
A1 *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.*	**A1:** The outcome has been achieved through the doctoral student having attended third-cycle courses, and read and followed relevant scientific literature. The outcome can be verified through e.g. the authoring of well-balanced introductions and backgrounds in scientific articles, conference papers and the introduction to the doctoral thesis, as well as through the student's ability to present and discuss their own and others' research results at conferences and seminars.
A2 *Demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.*	**A2**: The outcome has been achieved through the doctoral student having e.g. participated in relevant third-cycle courses and identified and used methods relevant to the subject to solve the research questions posed in the thesis and scientific articles.
Competence and skills	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
B1: *Demonstrate the capacity for scientific analysis and synthesis as well as to review and assess new and complex phenomena, issues and situations autonomously and critically.*	**B1**: The outcome has been achieved through the doctoral student having e.g. identified previously unobserved phenomena and proposed new research questions, contributed with a scientific explanation and drawn relevant conclusions in the scientific articles and conference papers which the doctoral student authored/co-authored.
B2: *Demonstrate the ability to identify and formulate issues with scientific 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.*	**B2**: The outcome has been achieved and verified through the doctoral student having e.g. critically reviewed previous work in the field, summarised in the scientific articles which the doctoral student authored/co-authored as well as in the licentiate/doctoral thesis; and by the student solving the research questions posed by applying this knowledge to choose an appropriate solution methodology. The final assessment of this outcome is made by the examining committee for the thesis defence.
B3: *Demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through their own research.*	**B3:** The outcome has been achieved and verified by the thesis being approved by an examining committee.
B4: *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 scientific community and society in general.*	**B4:** The outcome has been achieved through the doctoral student having e.g. given presentations at scientific conferences and/or presentations in an industrial context, and has been achieved and verified through a thesis discussed at a public defence and approved by an examining committee.
B5: *Demonstrate the ability to identify the need*	***B5:*** The outcome has been achieved through the doctoral student having

for further knowledge. ***B6:*** *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.*	e.g. identified the need for new knowledge and used this as a basis for proposing new research. This is documented to some extent in the scientific articles and should be discussed in the thesis. ***B6:*** The outcome has been achieved through the doctoral student having e.g. taught at the first-cycle level or given company presentations, assisted in the supervision of degree projects, or participated in knowledge transfer to industrial partners (where applicable).
Judgement and approach	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
C1: *Demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics.* ***C2:*** *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.*	***C1:*** The outcome has been achieved through the doctoral student having assessed and discussed, where relevant, ethical aspects with the supervisor when selecting and formulating research problems. The impact of the research results on society at large should be discussed with the supervisor. Intellectual independence is made explicit by e.g. the doctoral student clearly presenting their own contributions in the thesis. Scientific integrity is verified through e.g. the plagiarism check carried out on the thesis. ***C2:*** The outcome has been achieved through the doctoral student having participated in and followed discussions and debates in the academic environment locally (department level) and in a broader context.

Degree of Licentiate

Knowledge and understanding	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
Demonstrate *knowledge and understanding* in the field of research, including *current* specialist knowledge in a limited area of this field. *Main difference compared to the Degree of Doctor: For the Degree of Licentiate, it is sufficient to demonstrate "knowledge and understanding", as opposed to "broad knowledge and systematic understanding". In addition, "advanced and up-to-date specialised knowledge" is replaced with "current specialist knowledge".*	The outcome has been achieved through the doctoral student having **A1.1:** authored original scientific papers in which their own contributions are significant and identifiable. The papers are of such quality that they have been published, or are expected to be published, in peer-reviewed international scientific journals or conferences. **A1.2:** demonstrated both broad and specialised knowledge in the research area by writing a licentiate thesis in which the research results were positioned and discussed in a broader perspective, and presented a reference list of other researchers' results that spans the relevant breadth of the research area. **A1.3:** in a seminar, course or a licentiate thesis and its public defence, demonstrated 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. **A1.4:** actively participated in seminar activities in which their own results were presented and discussed, and asked questions and provided feedback on the presentations on other students and researchers.
Competence and skills	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
Demonstrate the ability to identify and formulate issues with scientific 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. *Main difference compared to the Degree of Doctor: For the Degree of Licentiate, there is emphasis that the student is to undertake a "limited piece of research" that is to contribute to the formulation of knowledge, as opposed to the Degree of Doctor, which specifies that the student is to demonstrate the ability to "undertake research".*	The outcome has been achieved through the doctoral student having **B1.1:** demonstrated the ability to independently formulate and critically analyse both existing and new complex phenomena. **B1.2:** presented examples of their own questions that have been tested within the context of their own research project, and presented their choice of method and the outcome. If any results were not as expected, the doctoral student shall have explained the possible sources of error and the measures taken to move the project forward. **B1.3:** presented examples of independently conducted experiments/simulations/tasks preceded by detailed time planning. **B1.4:** presented examples of, and explained and argued for, the choice of methods for individual experiments. **B1.5:** explained how it was ensured that the training 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.
Demonstrate the ability in both national and international contexts to present and discuss	The goal has been achieved through the doctoral student having

research and research findings *clearly* in speech and writing and in dialogue with the scientific community and society in general. *Main difference compared to the Degree of Doctor: For the Degree of Licentiate, the requirement is for the student to communicate their research "clearly", as opposed to communicating "authoritatively".*	**B2.1:** where applicable, participated in national and international conferences and presented their own research results in speech or poster form, and participated in scientific discussions with other researchers in the research area. **B2.2:** described how experience from conference or seminar presentations contributed to the development of their own ability to communicate and defend scientific results, how the presentations were received by other participants, and whether valuable information could be obtained that helped their own studies progress. **B2.3:** been assessed with a passing grade for the intended learning outcomes in communication or presentation techniques in an appropriate compulsory or elective third-cycle course **B2.4:** described basic concepts, tools and methods in presentation or communication techniques, as well as demonstrated the ability to put knowledge into practice by formulating different types of scientific presentation material of good quality. **B2.5:** presented their own research results in a pedagogical manner to other students and researchers at academic seminars, to a general audience or to another category of audience, 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. **B2.6:** participated in outreach activities related to their own research in order to contribute to the dissemination and exchange of knowledge with relevant stakeholder groups, such as other higher education institutions, companies, authorities, schools, etc.
Demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity. *Main difference compared to the Degree of Doctor: The doctoral student's future contribution to society through research and education is downplayed, and the focus is placed on the doctoral student's ability to work in areas that require research skills but not a doctoral degree.*	The outcome has been achieved through the doctoral student having **B3.1**: authored original scientific papers in which their own contributions are significant and identifiable. The papers are of such quality that they have been published, or are expected to be published, in peer-reviewed international scientific journals or conferences. **B3.2**: authored a licentiate thesis based on their own studies of good scientific and linguistic quality, which has been defended and discussed at a licentiate seminar, and assessed with a passing grade by an independent examiner.
Judgement and approach	
Intended learning outcomes	**Assessment criteria with reference to numbering in eISP**
Demonstrate the ability to make assessments of ethical aspects *of their own research*. *Main difference compared to the Degree of Doctor: The ability to make assessments of research ethics is limited to the student's own research and not in general.*	The outcome has been achieved through the doctoral student having **C1.1:** demonstrated intellectual integrity in the sense that their own choices and positions have been justified and defended based on independent critical thinking in relation to proven experience and scientific basis. **C1.2:** described how they ensured that their own scientific procedure in theory and practice was carried out in an honest and ethical manner. **C1.3:** 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. **C1.4:** been assessed with a passing grade for the intended learning outcomes in ethics in a suitable compulsory or elective third-cycle course. The doctoral student is thus expected to be able to account for fundamental theories in research ethics and relate these to their own approach and research work.
Demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used. *Main difference compared to the Degree of Doctor: For the Degree of Licentiate, only "insight" is required, as opposed to "specialised insight for the doctoral degree.*	The outcome has been achieved through the doctoral student having **C2.1:** 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. **C2.2:** 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 in which their own research results can be used in both a positive and a negative way. **C2.3:** demonstrated a 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. **C2.4:** described how their own actions and approach take the concept of sustainability into account.
Demonstrate the ability to identify the personal need for further knowledge and take responsibility for their ongoing learning. *Main difference compared to the Degree of Doctor: Same requirement to be able to identify the need for further knowledge, with the addition of being able to take responsibility for one's own knowledge development, which is considered implicit in a doctoral degree.*	**C3.1:** 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 doctoral student him/herself must have realised that knowledge was lacking and handled this with measures relevant to the purpose. **C3.2:** 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. **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.