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School of Engineering Sciences in
Chemistry, Biotechnology and
Health

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

This regulatory document has been decided by the President (V-2017-0548) pursuant to chapter 6 sections 26-27 of the Higher Education Ordinance. The regulatory document is valid with effect from 10-05-2017 and was last modified on 06-12-2023 (V-2023-0680). 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 in Chemistry, Biotechnology and Health 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

Kemiteknik (Chemical Engineering)

1.2 Subject description

Chemical Engineering is a third-cycle subject focusing on technological processes or systems where the principles of chemistry are applied. It integrates chemistry, physics, and mathematics with engineering and is based on experimental activities, modelling and simulation of processes, and analysis of technological systems or industrial processes, as well as socio-technical and global systems. Research in the subject combines fundamental knowledge with engineering tools to analyse complex systems, develop new products and processes, and analyse their applicability in a broader multidisciplinary context. The research at the Department of Chemical Engineering at KTH is mainly focused on environmental and energy issues. Examples of research activities are the development of electrochemical storage and energy and material conversion in batteries, fuel cells and electrolysis, adsorption processes such as carbon dioxide capture, heterogeneous catalysis including for purification processes, thermochemical conversion of biomass, separation processes for material recycling, and socio-technical system studies.

1.3 Specialisations

The subject has no specialisations.

1.4 Organisation of the education

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

Below are described activities for the doctoral student's fulfilment of the learning outcomes for third-cycle education according to the Higher Education Ordinance (HF) and KTH's goals. The individual study plan (ISP) specifies the activities for each individual doctoral student.

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.

This goal can be achieved by the doctoral student continuously training and developing their ability to plan and carry out their own research, acquire both broad and specialised knowledge from scientific literature relevant to the research area, and actively present their own research results in the form of scientific publications and at national and international conferences, seminars or workshops. To achieve the goal, the student takes courses that build on knowledge from previous courses and that provide both broad and deep understanding of the research area, including seminar courses where the research work of other doctoral students and researchers is critically reviewed, analysed and discussed, as well as writing and defending a doctoral thesis. It is recommended that the doctoral student be examined on a third-cycle seminar course in the subject of chemical engineering or other subjects deemed to be directly relevant to the current specialisation. The seminar course, which could be examined by the doctoral student's principal supervisor, includes active participation in seminar activities internally or externally, where the doctoral students' results are presented and discussed regularly for in-depth study of the research subject. The course also includes attendance at public PhD/licentiate defences hosted by the department, to allow for increased breadth of knowledge acquisition in the research subject of chemical engineering.

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

This goal can be achieved by the doctoral student continuously training and developing their ability to identify, justify, and analyse relevant issues and the choice of appropriate methods, acquire knowledge and thoroughly and critically review scientific work in their own research area, and practically apply different methods in their research. To achieve this goal the student studies and is examined on courses and participates in workshops and scientific seminars with a methodological focus relevant to the subject and research area, as well as studying courses in, for example, scientific and research methodology.

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.

This goal can be achieved by the doctoral student continuously training and developing their ability to plan and carry out their own research, obtain knowledge from scientific literature relevant to the research area, and actively present their own research results in the form of scientific publications and at national and international conferences, seminars or workshops. To achieve this goal, the student takes courses relevant to the research area, including seminar courses where the research work of other third-cycle students and researchers is critically reviewed, analysed, and discussed, as well as writing and defending a licentiate thesis.

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.

This goal can be achieved by the doctoral student continuously training and developing their ability to independently interpret, analyse, discuss, and compile research results, and to actively reflect on possible sources of error and alternative approaches to deal with complex issues. To achieve this goal, the student carries out interdisciplinary activities and engages in interdisciplinary reasoning, independently evaluates reasons why experiments have not yielded expected results and based on these insights, proposes new ways to advance the research or issue and to test scientific hypotheses.

- 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.

This goal can be achieved by the doctoral student continuously training and developing their ability to independently plan and carry out relevant studies and experiments with clear objectives in a valid way and within time frames adequate for the task, making decisions based on existing literature, their own experience, and reflection on their own results formulate new scientific questions, hypotheses, and approaches to be answered and tested, and compile their own results and relate these to the published results of others.

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

This goal is achieved by the doctoral student independently having planned and carried out experimental or theoretical studies on a sound and proven scientific basis and, with scientific research methodology relevant to the research subject, analysed and critically reviewed their own results and compiled these in written form as articles published in peer-reviewed international scientific journals or as manuscripts of sufficiently good quality that they can be assumed to be publishable in peer-reviewed international scientific journals, as well as having summarised their own research results in a doctoral thesis, where these have also been put in relation to existing knowledge in the research area, and having defended and discussed the results in a meritorious manner 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 academic community and society in general.

This goal can be achieved by the doctoral student continuously training and developing their ability to take personal responsibility for writing scientific work, present their research results to experts in the field and a broader audience, relate their own research results to the current state of knowledge in the research area and the industry in which the results can be applied, present

their own research results with authority and in a pedagogical way to other researchers and students at academic seminars, and be examined in courses where presentation and discussion of their own research results are included as compulsory elements

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

This goal can be achieved by the doctoral student continuously training and developing their ability to stay informed and updated on national and international developments in their own research area and neighbouring areas, critically reflect on how their own theoretical and methodological approaches relate to the overall knowledge base and leading edge research, critically reflect on whether their own knowledge and methodology are adequate or need to be further developed, identify and formulate questions that would be justified to investigate in order to further develop their own research project from a basic research or applied research perspective, identify which methods are suitable for the purpose, and develop 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 goal can be achieved by the doctoral student continuously training and developing the ability to identify issues that can benefit the surrounding society, communicate their own research results in writing, present to and discuss with other researchers at academic seminars and seminar courses, collaborate with other researchers and interact with actors within and outside academia, teach and supervise students in a pedagogical manner at first-cycle and second-cycle level after having graduated from a compulsory course in higher education pedagogy at third-cycle level, and present their own research results to the general community, for example, at meetings with industry actors, in popular science journals, or for pupils at primary or secondary school level

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.

This goal can be achieved by the doctoral student continuously training and developing their ability to independently plan and carry out limited research tasks with clear objectives within time frames adequate for the task, formulate scientific questions, hypotheses, and approaches to be answered and tested based on existing literature and their own experience of, and reflections on, their own results, and compile their own results and relate these to the published results of others.

- 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.

This goal can be achieved by the doctoral student continuously training and developing their ability to take personal responsibility for writing scientific work, present their research results to other researchers in the research area, relate their own research results to the current state of knowledge in the research area and the industry in which the results can be applied, and present their own research results in a pedagogical manner to other researchers and students at academic seminars. To demonstrate achievement of this goal the student is examined in courses where presentation and discussion of their own research results are included as compulsory elements.

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

This goal can be achieved by the doctoral student continuously practising and developing their ability to communicate their own research results in writing in the form of scientific publications and a licentiate academic paper, pedagogically present to and discuss with other researchers within or outside academia, and discuss and critically review their own and others' research results within the framework of compulsory seminar courses. Achievement is demonstrated by taking a compulsory course in higher education pedagogy at doctoral 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.

Goal fulfilment includes examination of a subject course in research ethics. In addition to a mandatory subject course in research ethics, other courses with individual learning outcomes in ethics can contribute to further progression towards goal fulfilment. Progression towards the goal is also achieved by the doctoral student continuously training and developing their ability to independently formulate and critically review their own and others' research, carry out research tasks in an honest and ethical manner, make ethical assessments by reflecting on and dealing with any ethical dilemmas that may arise in their own research area and in research in general, and demonstrate intellectual integrity by critically justifying and defending their own positions based on proven experience and scientific basis. Furthermore, achievement is demonstrated by being examined regarding the compulsory part of the course component that includes a course or course module with learning outcomes in the field of research ethics.

- 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 goal can be achieved by the research student continuously training and developing their ability to thoroughly reflect on both expected and unexpected results and handle the results adequately, reflect on the opportunities and limitations of their own research project, and reflect on the opportunities and limitations of their own research in a broader social science perspective.

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 fulfilment includes an examination in a subject course in research ethics. In addition to a mandatory subject course in research ethics, other courses with individual learning outcomes in ethics can contribute to further progression towards goal fulfilment. Progression towards the goal is also achieved by the doctoral student continuously training and developing their ability to independently formulate and critically review their own research results, carry out research tasks in an honest and ethical manner, and make ethical judgements 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 goal can be achieved by the doctoral student continuously training and developing their ability to reflect on both expected and unexpected results and to handle the results adequately, reflect on the opportunities and limitations of their own research project, as well as 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 his or her ongoing learning.

This goal can be achieved by the doctoral student continuously training and developing their ability to keep informed and updated on national and international developments in their own research area and neighbouring areas, critically reflect on how their own theoretical and methodological approaches relate to the overall knowledge base and leading edge research and whether their own knowledge and methodology are adequate or need to be developed, identify and formulate questions that would be justified to investigate in order to further develop their own research project from a basic research or applied research perspective, identify which methods are suitable for the purpose, and develop the ability to adapt their own perceptions based on the acquisition of new knowledge.

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.

In addition to a compulsory subject course in sustainable development, other courses with individual learning outcomes in sustainable development can contribute to further progression towards goal fulfilment. This goal also includes education on gender equality, diversity, and equal opportunities, as well as climate-neutral and climate-improving societal development. For further progression towards the goal, the doctoral student should continuously train and develop their ability to explain how their own research, behaviour, and approach take into account aspects of sustainable development, critically evaluate and reflect on how their own research can be conducted in a sustainable manner by taking into account its direct or indirect economic, social, or environmental consequences and impact on the immediate or distant environment, and, on their own initiative, acquire knowledge and reflect on sustainable development in a broader global perspective.

1.4.2 Compulsory courses

To promote the fulfilment of the degree objectives, compulsory elements are included for both doctoral and licentiate research students.

The current range of courses is constantly 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 at its own school and, if necessary, to provide information on suitable courses and course activities outside the school and university.

1. Third-cycle course in higher education pedagogy, at least 3.0 credits for doctoral and licentiate degrees.

Refers to a third-cycle subject course in higher education pedagogy established at a Swedish higher education institution, which should include both theory and elements of practical teaching and/or supervision. For doctoral students who are going to teach, it is recommended that the course is completed and approved before teaching begins. Examples of courses in higher education pedagogy offered by KTH can be found in Appendix 2. Suitable courses for doctoral students in the subject are Basic communication and teaching theory 3.0 credits and Supervision methodology for project work 6.0 credits, where doctoral students with a doctoral degree as a goal are recommended to take both of these courses.

2. Third-cycle course in research ethics, at least 2.0 credits for doctoral and licentiate degrees.

Refers to a third-cycle course in research ethics/research integrity established at a Swedish university. Examples of third-cycle courses in research ethics offered at KTH can be found in Appendix 2. A suitable course for doctoral students in the subject is Research Integrity 2.0 credits.

3. Third-cycle course in sustainable development, at least 3.0 credits for doctoral and licentiate degrees.

Refers to a third-cycle subject course in sustainable development established at a Swedish university with learning outcomes specified in the syllabus for examination of knowledge and skills in sustainable development where the grade Pass is obtained. KTH's degree objectives for sustainable development also include that knowledge and skills are examined in the area of equality, diversity, and equal treatment, as well as society's climate transition and development towards climate neutrality. Examples of courses in sustainable development at third-cycle level offered at KTH can be found in Appendix 2. A suitable course for doctoral students in the subject is Engineering for a Sustainable Society 3.0 credits.

1.4.3 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, scientific writing, communication, and literature studies. Examples of current courses can be found in Appendix 2. Doctoral students should also actively search for and propose suitable learning activities that, in addition to the compulsory courses, aim at further progression towards the degree objectives and completion of necessary knowledge, and consult with supervisors and the Director of Third-Cycle Education or Programme Director about the suitability of the proposed course activities.

1. Seminar course in chemical engineering at third-cycle level, 4 credits for doctoral and licentiate degrees.

The student is strongly recommended to study and be examined on a special seminar course at third-cycle level in the subject of chemical engineering or other subjects deemed to be directly relevant to the current specialisation. The seminar course in Chemical Engineering includes both participation in regular seminar activities where one's own and others' research in a relevant field is presented and discussed to show a depth of knowledge, and attendance at all the department's public defences is required to show a breadth of participation. The seminar courses given within the programme are important tools to support progression towards the degree objectives of the Higher Education Ordinance as they provide both broad and specialised knowledge within one's own and the overall subject area and provide skills in oral and visual communication of research results within the research and subject area, as well as the critical review of one's own and others' research results. The seminar courses meet regularly during term time and are led by experienced teachers actively engaged in research in the field, who have a good knowledge of the research area, research premises, academic authorship, peer review, and publication strategies relevant to the research topic.

1.4.4 Conditional elective courses

The general curriculum for this third-cycle subject area does not specify any conditional 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 degree. However, all courses and course activities that are not established by any Swedish university must be validated by the programme's third-cycle coordinator or programme coordinator before they can be included in the course part of the individual study plan and degree.

Within the framework of individual commitment, higher education credits can be obtained for completed and documented conference contributions. These refer to oral presentation, poster presentation, and pitch presentation. For each individual presentation form, higher education credits can be awarded on only one occasion, provided that it is also described in the course part of the individual study plan.

Online distance-learning (remote) courses can be included in the individual study plan provided that their quality can be verified by the doctoral student and supervisor with the necessary documentation for validation. The scope, level, and mode of examination must be documented in the manner prescribed by general and local regulations. Any credit transfer is decided by the Director of Third-Cycle Education or Programme Director or third-cycle programme coordinator/programme coordinator.

A course already established at first or second cycle cannot be recognised as a third-cycle course.

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

Normally, a doctoral degree in this subject includes a thesis comprising 180 credits.

Thesis

Quality requirements and possible other requirements for the thesis.

Composite thesis

The thesis should be based on research results that are 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 higher education credits (three years of full-time study) and has a recommended scope corresponding to four scientific articles, where the doctoral student is the main author of at least two articles, of which at least one is accepted for publication in a peer-reviewed journal. However, the number of articles may vary depending on the scope, scientific quality and level, and the doctoral student's contribution to each work.

According to KTH's guidelines for third-cycle education, it is mandatory that a doctoral thesis is reviewed by a formally appointed preliminary reviewer in addition to the principal supervisor.

In cases where a doctoral thesis is based solely on work that has not yet been published or accepted for publication in international peer-reviewed scientific journals, the thesis must be reviewed by two additional independent researchers with good knowledge of the research area and by the Director of Third-Cycle Education, in addition to the supervisor and the mandatory pre-reviewer.

Monograph thesis

A doctoral thesis can also be written as a monograph, which is a relatively comprehensive coherent scientific publication. Previous publications can be added as appendices to a monograph. The decision to approve this form of thesis is made on a case-by-case basis by the Director of Third-Cycle Education. In cases where a monograph is considered applicable, its content must be of such a scientific level that the content as a whole, or most of it, can be considered to fulfil the requirements for publication in scientific journals of good international quality that apply peer review.

Before submission, a monograph must be pre-reviewed by the principal supervisor, a formally appointed pre-reviewer, two independent researchers with good knowledge of the research area, and the Director of Third-Cycle Education.

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.

Normally a doctoral degree in this subject has a course component of 60 higher education credits (one year of full-time study) which includes at least 45 higher education credits at third-cycle level and a maximum of 15 higher education credits at second-cycle level

Degree of Licentiate

A Degree of Licentiate comprises at least 120 credits. At least 60 credits must consist of the thesis.

Normally, a licentiate degree in this subject includes a thesis comprising 90 credits.

Thesis

Quality requirements and possible other requirements for the licentiate thesis.

Composite 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. An academic paper in this subject normally comprises 90 higher education credits (one and a half years of full-time study) and has a recommended scope corresponding to two scientific articles, where the doctoral student is the main author of at least one article, of which at least one is accepted for publication in a peer-reviewed journal. However, the number of articles may vary depending on the scope, scientific quality and level, and the doctoral student's contribution to each work.

According to KTH's guidelines for third-cycle education, it is mandatory that a licentiate academic paper be reviewed by a formally appointed preliminary reviewer in addition to the principal supervisor.

In cases where a licentiate thesis is based solely on work that has not yet been published or accepted for publication in international peer-reviewed scientific journals, the academic paper must be reviewed by two additional independent researchers with good knowledge of the research area and by the Director of Third-Cycle Education, in addition to the supervisor and the mandatory pre-reviewer.

Monograph Licentiate Thesis

A licentiate thesis paper can also be written as a monograph, which is a relatively comprehensive coherent scientific publication. Previous publications can be added as appendices to a monograph. The decision to approve this form of academic paper is made on a case-by-case basis by the Director of Third-Cycle Education. In cases where a monograph is considered applicable, its content must be of such a scientific level that the content as a whole, or most of it, can be considered to fulfil the requirements for publication in scientific journals of good international quality that apply peer review.

Before submission, a monograph Licentiate Thesis must be pre-reviewed by the principal supervisor, a formally appointed pre-reviewer, an additional independent researcher with good knowledge of the research area, and the Director of Third-Cycle Education.

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

Normally a licentiate degree in this subject has a course component of 30 higher education credits (half a year of full-time study) which includes at least 15 higher education credits at third-cycle level and a maximum of 15 higher education credits at second-cycle level.

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

Follow-up of the individual study plan. It is mandatory for supervisors and doctoral students to jointly update the individual study plan regularly, at least once in each 12-month period (i.e. the most recent study plan must never be more than 12 months old). The individual study plan shall be designed so that it ensures that the degree objectives of the Higher Education Ordinance and KTH's objectives can be fulfilled within the specified time. The general programme syllabus shall be used as support in the work of writing and updating the individual study plan. Progression towards goal fulfilment shall be evaluated by supervisors and research students at the mandatory regular updates of the individual study plan. The doctoral student reflects on, exemplifies, and justifies how completed and ongoing study activities have promoted

progression since the last update. Justification of progress shall be made in writing in the designated section of the electronic individual study plan (eISP), preferably by the doctoral student themselves. All elements of the programme, including thesis work, courses, workshops, conferences, outreach activities, etc. must be taken into account.

The choice of courses and learning activities that are not compulsory is made by agreement between the doctoral student and the supervisor. At the annual follow-up, planned courses and learning activities are entered in the individual study plan for the coming year.

Half-time seminar. This seminar is compulsory and is held after half of the study period. Third-cycle studies with a doctoral degree as the target comprise 48 months of full-time studies (100% activity) if 0% departmental service is included, and 60 months of studies (80% activity) if 20% departmental service is included. The estimated time for a half-time seminar for a doctoral degree as the target is therefore 24-30 months. Studies at third-cycle level with a licentiate degree as the target include 24 months of full-time studies (100% activity) if 0% departmental service is included, and 30 months of studies (80% activity) if 20% departmental service is included. The estimated time for a half-time seminar for a licentiate degree as a target is therefore 12-15 months. The lower- and upper-time limits refer to studies with 0% and 20% departmental service respectively. Note that 20% is the maximum percentage of departmental service allowed. In addition to the seminar itself, where the doctoral student presents research results and completed courses as well as other activities carried out to achieve the degree objectives, the doctoral student writes a short report on the results achieved. Two evaluators read the report, participate in the seminar, and provide feedback to the doctoral student and supervisor. Details for conducting the mid-term seminar are available to all concerned on the school's intranet.

Scientific exchange and communication. Active participation in scientific exchange by presenting one's own research results at international conferences, major national conferences, workshops, summer schools or company-organised events. Active participation here means a scientific lecture, an oral research presentation in pitch format, or a poster presentation to a scientific audience.

Mid-year seminars. It is recommended that doctoral students with a doctoral degree as their target also present their research results and achieved goals at so-called mid-year seminars. Mid-year seminars refer to a seminar opportunity halfway between the start of the study period and the mid-term seminar, and halfway between the mid-term seminar and the completion of the doctoral studies. The format of the mid-year seminar is determined by the doctoral student and supervisor in consultation but should include a check on progress towards the degree objectives, be open to at least their own department, and conclude with a brief written report according to a template with a description of the progress of the objectives achieved, sent to the doctoral programme administrator for archiving.

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

To be admitted to the third-cycle education in **Chemical Engineering**, the applicant must have passed courses resulting in at least 60 credits at minimum second-cycle level in **Chemical**

Engineering or other subjects deemed directly relevant to the chosen specialisation. These entry requirements can also be considered fulfilled by an applicant who has acquired essentially equivalent knowledge in arrangement.

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

2.2 Assessment criteria for testing the ability to assimilate the education

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 The other regulations needed

3.1 Transitional regulations

Doctoral students who have been admitted to an earlier syllabus have the right to change to the most recently adopted and valid general syllabus. The request to change to a later syllabus is made in writing to the Director of Third-cycle Studies. However, a change of general syllabus requires that the requirements for the new syllabus can be met within the existing time limit.

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

<p>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 the field.</p>	<p>The outcome has been achieved through the doctoral student having</p> <p>A1.1: 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>A1.2: 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>A1.3: demonstrated at a seminar, a course, in the thesis, or at its public defence, a good ability to account for how their own research results relate to the research frontier within the field, and justify how their own results advance this.</p> <p>A1.4: 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>
<p>Demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.</p>	<p>The outcome has been achieved through the doctoral student having</p> <p>A2.1: 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>A2.2: described basic theories in scientific theory and correctly applied one or more of these in their own research.</p> <p>A2.3: 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>A2.4: justified their choice of method and execution in relation to the issue and to alternative methods.</p> <p>A2.5: 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>
<p>Competence and skills</p>	
<p>Intended learning outcomes</p>	<p>Assessment criteria with reference to numbering in eISP</p>
<p>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>	<p>The outcome has been achieved through the doctoral student having</p> <p>B1.1: demonstrated the ability to independently formulate and critically analyse both existing and new complex phenomena.</p> <p>B1.2: 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>B1.3: described the interpretation of the results and how these were combined with existing knowledge to give rise to a new explanatory model.</p>

	<p>B1.4: 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>
<p>Demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously, and creatively, 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>	<p>The goal has been achieved through the doctoral student having</p> <p>B2.1: presented examples of independently performed experiments, simulations, and/or tasks that were preceded by detailed time planning.</p> <p>B2.2: in cases where it is applicable, presented examples of their own hypotheses that have been tested within the framework of their own research project, including presentation of the choice of method and outcome of the work. 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>B2.3: presented examples of and described and argued for the choice of methods for individual research tasks.</p> <p>B2.4: 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 through a dissertation the ability to make a significant contribution to the formation of knowledge through one's own research.</p>	<p>The goal has been achieved through the doctoral student having</p> <p>B3.1: 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>B3.2: authored a thesis based on their own scientific work, of good scientific and linguistic quality, which was authoritatively defended and discussed in a public defence of the doctoral thesis, and examined with a passing grade by an independent examining committee.</p>
<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>	<p>The goal has been achieved through the doctoral student having</p> <p>B4.1: 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>B4.2: 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 progress.</p> <p>B4.3: been examined with a passing grade for intended learning outcomes in communication or presentation technology in a suitable compulsory or optional course at third-cycle level.</p> <p>B4.4: described basic concepts, tools, and methods in presentation or communication technology, as well as demonstrated an ability to put such knowledge into practice by formulating different types of scientific presentation material of good quality.</p> <p>B4.5: presented their research results in a pedagogic way for other</p>

	<p>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 pedagogic knowledge, adapted to the audience's knowledge level, and where the doctoral student answered questions at an adequate level for the audience.</p> <p>B4.6: 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>B5.1: 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 to carry out the task. This may pertain to a wide range of diverse tasks and knowledge, as long as the third-cycle students themselves realised that knowledge was lacking and handled this with measures relevant to the purpose.</p> <p>B5.2: demonstrated insight that the knowledge frontier 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>B5.3: demonstrated the ability to question, evaluate and adapt their perception of their own level of knowledge and ability in relation to the prevailing knowledge frontier.</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>B6.1: 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>B6.2: 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>B6.3: actively supervised other students in theoretical and/or practical projects. Third-cycle students should, with examples, 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 the different roles of teachers and students and how personal dynamics and supervision techniques can affect the outcome of learning and interaction.</p> <p>B6.4: been examined with a passing 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</p>

	<p>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>B6.5: 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, thereby acquiring general knowledge and skills required in different societal functions.</p>
Judgement and approach	
Intended learning outcomes	Assessment criteria with reference to numbering in eISP
<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>C1.1: 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>C1.2: described how they ensured that their own scientific procedure in theory and practice was carried out in an honest and ethical manner.</p> <p>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.</p> <p>C1.4: been examined with a passing 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>C2.1: presented concrete examples of how their own research results, and the research area in general, can contribute new knowledge to the research frontier in the area, and justify its societal relevance.</p> <p>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 identifying possible situations where their own research results can be used in both a positive and negative way.</p> <p>C2.3: 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>C2.4: described how their own actions and approach take into account the concept of sustainability.</p>

	C2.5: been examined with a passing 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.
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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 their 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>A1.1: 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>A1.2: 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>A1.3: demonstrated at a seminar, a course, in the licentiate thesis, and/or in its public defence, a good ability to account for how their own research results relate to the research frontier within the field, and justify how their own results advance this.</p> <p>A1.4: actively participated in seminar activities where their own results were presented and discussed, as well as asking questions and providing 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 autonomously and creatively identify and formulate issues with scholarly precision critically, 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</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p>B1.1: demonstrated the ability to independently formulate and critically analyse both existing and new complex phenomena.</p> <p>B1.2: presented examples of their own questions that were tested within the framework of their own research project, as well as describing 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>B1.3: presented examples of independently performed experiments, simulations, and/or tasks that were preceded by detailed time planning.</p>

<p><i>degree where one must be able to show the ability to “conduct research.”</i></p>	<p>B1.4: presented examples of and described and argued for the choice of methods for individual experiments.</p> <p>B1.5: 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, in 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>B2.1: in cases where it is applicable, participated in national and international conferences and presented their own research results in poster form or oral presentation, as well as participated in scientific discussions with other researchers in the research field.</p> <p>B2.2: 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 progress.</p> <p>B2.3: been examined with a passing grade for intended learning outcomes in communication or presentation technology in a suitable compulsory or optional course at third-cycle level.</p> <p>B2.4: described basic concepts, tools, and methods in presentation or communication technology, as well as demonstrating the ability to put such knowledge into practice by formulating different types of scientific presentation material of good quality.</p> <p>B2.5: presented their research results in a pedagogic 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 pedagogic knowledge, adapted to the audience’s knowledge level and also answered questions at an adequate level for the audience.</p> <p>B2.6: 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 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.</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p>B3.1: 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>B3.2: authored a licentiate thesis based on their own studies of good 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>Judgement and approach</p>	
<p>Intended learning outcomes</p>	<p>Assessment criteria with reference to numbering in eISP</p>
<p>Demonstrate the ability to make assessments of ethical aspects of his or her own research.</p>	<p>The goal has been achieved through the doctoral student having</p> <p>C1.1: demonstrated intellectual integrity in the sense that their own</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>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>C1.2: described how they ensured that their own scientific procedure in theory and practice was carried out in an honest and ethical manner.</p> <p>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.</p> <p>C1.4: been examined with a passing 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 the “in-depth insight” required for the doctoral degree.</i></p>	<p>The goal has been achieved through the doctoral student having</p> <p>C2.1: presented concrete examples of how their own research results, and the research area in general, can contribute new knowledge to the research frontier in the area, and justify its societal relevance.</p> <p>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 where their own research results can be used in both a positive and negative way.</p> <p>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.</p> <p>C2.4: 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 development, which may be considered to be implied for a doctoral degree.</i></p>	<p>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 pertain to a wide range of potential tasks and knowledge, as long as the third-cycle students themselves must have realised that knowledge was lacking and handled this with measures relevant to the purpose.</p> <p>C3.2: demonstrated insight that the knowledge frontier in higher education and research is in a constant state of 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>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 frontier.</p>

