REGULATION

Valid from
2024-01-30

Reference number
V-2023-0908 3.2.3

Decision-maker
President

Revised as of
Click or tap here to enter the date.

Entity responsible for supervision and questions
School of Architecture and the Built Environment

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

This regulatory document has been decided by the President (V-2023-0908) pursuant to chapter 6 sections 26-27 of the Higher Education Ordinance. The regulatory document is valid with effect from 30-01-2024. The regulatory document regulates the main content of the education, requirements for special qualifications and the other regulations that are needed. The School of Architecture and the Built Environment 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

Miljöteknik, Environmental Engineering

1.2 Subject description

The subject of Environmental Engineering includes studies that draw broadly on natural sciences such as physics, chemistry, biology, ecology, geology, hydraulics, hydrology and mathematics, combined with engineering, social sciences and systems analysis, to create new knowledge and new technologies that improve environmental quality and human life while adapting technologies and other solutions to natural conditions.

The subject of Environmental Engineering deals with issues related to the sustainable use of natural resources, including, among others, climate action and adaptation, water-resource management, water supplies, water pollution, biochemical processes, wastewater management, hydrological and hydraulic systems analysis, flood protection, groundwater resources, hydropower, sustainable renewable energy systems, urban-regional systems, transport infrastructure and sustainable land use, spatial and environmental systems analysis and environmental assessment.

The natural environment and its interaction with technology, infrastructure and human solutions are studied from societal and sustainability perspectives, as well as being linked to social sciences in a systems perspective. Research focuses on the requirements for achieving a sustainable society, and includes an understanding of processes, technological developments and society's governance capabilities.

1.3 Specialisations

There are two specialisations within Environmental Engineering:

- Land and Water Resources Engineering
- Hydraulics and Technical Hydrology

These are described under headings 4 and 5. Doctoral students are admitted to one of these 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 specifies the activities for each individual doctoral student.

Learning outcomes: Knowledge and understanding

For the Degree of Doctor the doctoral student shall:

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

Activities to achieve this outcome are reading relevant scientific literature in the research field, active participation in seminars, writing original scientific papers to which the student makes significant contributions and which are publishable in international scientific journals, and writing a doctoral thesis in which the research results are situated and discussed in a broader perspective. The outcome is also examined in the *Hydrological Transport Processes* and Land and *Water Resources Engineering core courses*.

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

Activities to achieve these outcomes are ensured through the compulsory course *Introduction to the Philosophy of Science and Research Methodology* and by relating the course content to one's own research, the application of methods appropriate to the research area and critical review and interpretation of the results, as well as justification of the choice of method and execution in relation to the research question, and to alternative methods and to the research frontier in the area. The outcome is also examined in the *Hydrological Transport Processes* and Land and *Water Resources Engineering core courses*. The ability to apply and present scientific methodology relevant to the research problem at hand is tested through the publication of original scientific work in international scientific journals.

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.

Activities to achieve the outcome are reading relevant literature for the research area, active participation in seminars, writing original scientific papers to which one makes significant contributions that are publishable, and writing a licentiate thesis in which the research results are situated and discussed in a broader perspective. The outcome is also examined in the *Hydrological Transport Processes* and *Land and Water Resources Engineering core courses*.

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.

Activities to achieve the outcome are active participation in research seminars, being able to independently formulate and critically examine existing and new complex phenomena and processes, analyse data, present analysis and interpretation of results, and draw relevant conclusions in coordination with the supervisor. This is also developed in the compulsory course *Introduction to the Philosophy of Science and Research Methodology*. The outcome is also examined in the *Hydrological Transport Processes* and *Land and Water Resources Engineering core courses*.

- 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.

Activities for achieving the outcome are to identify and formulate one's own scientific questions, choose methods and plan and carry out investigations according to the same, justify the choice of method and how this relates to given time frames. This is done with the support of supervisors, as well as in collaboration with colleagues and relevant stakeholders in connection with seminars, conferences and the like.

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

Activities to achieve the outcome are to write original scientific papers in which one's own contributions are significant and identifiable and publishable in international scientific journals, to write a thesis based on the scientific papers, which is presented, discussed and defended at a public defence of doctoral thesis and examined by an independent grading committee.

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

Activities to achieve the outcome are to participate in national and international conferences and present one's own research results, participate in scientific discussions with other researchers in the field, be examined in a course in communication technology, design scientific presentation material, and present the research at seminars for researchers and stakeholders.

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

Activities to achieve the outcome are to thoroughly and critically review scientific literature and to account for the absence of essential knowledge and how it affected one's own results. This is done with the support of supervisors, as well as in collaboration with colleagues and relevant stakeholders in connection with seminars, conferences and the like.

- 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.

Activities to achieve the outcome are active participation in seminars and other activities for other students, researchers and stakeholders, preparation of presentation material, active supervision of other students (if applicable). Doctoral students are given the opportunity to take the course *Basic Communication and Teaching* (3.0 credits) as part of the programme.

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.

Activities to achieve the outcome are to present examples of one's own scientific questions, present methods, justify them and carry out investigations according to such methods within the given time frame, identify possible sources of error and measures to move forward in the project. This is done with the support of supervisors, as well as in collaboration with colleagues and relevant stakeholders in connection with seminars, conferences and the like.

- 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.

Activities to achieve the outcome are to participate in national and international conferences and present one's own research results, participate in scientific discussions with other researchers in the field, be examined on a course in communication technology, design scientific presentation material, and present research at various conferences and seminars for researchers and stakeholders.

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

Activities to achieve the outcome are to write original scientific papers in which one's own contributions are significant, identifiable and publishable in international scientific journals, and to write a licentiate thesis based on one's own studies that is presented, discussed and defended at a licentiate seminar. Doctoral students are given the opportunity to take the course *Basic Communication and Teaching* (3.0 credits) as part of the programme.

Learning outcomes: Judgement and approach

For the Degree of Doctor the doctoral student shall:

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

Activities to achieve the outcome are to present one's own research at seminars where one's choices and positions are explained and defended, to account for how one's scientific work has been carried out orally and in writing in various contexts, to discuss ethical positions in research in general through the compulsory doctoral course *Research Law and Ethics (*1.5 credits).

- 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.

Activities to achieve the outcome are to present one's own research at seminars where the relationship to sustainable social development is discussed, orally and in writing discuss one's own research in relation to the Sustainable Development Goals. In addition, these issues are addressed in the compulsory doctoral course Scientific Theory and Research Methodology (7.5 credits).

For a Degree of Licentiate, the doctoral student shall:

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

Activities to achieve the outcome are to present one's own research at seminars where one's choices and positions are explained and defended, and to account for how one's scientific work has been carried out orally and in writing in various contexts. In addition, the compulsory doctoral course *Research Law and Ethics* (1.5 credits) is taken.

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

Activities to achieve the outcome are to present one's own research at seminars where the relationship to sustainable social development is discussed, orally and in writing discuss one's own research in relation to the Sustainable Development Goals. In addition, these issues are addressed in the compulsory doctoral course Scientific Theory and Research Methodology (7.5 credits).

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

Activities to achieve the outcome are to thoroughly and critically review scientific literature and to account for the absence of essential knowledge and how it affected one's own results.

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.

Sustainable development issues are constantly topical in the research area and arise in supervision, seminars and doctoral courses. They are also treated as a natural part of the thesis work in the subject of Environmental Engineering. This outcome is achieved through course participation in *Hydrological Transport Processes* or *courses within Land and Water Resources Engineering*, the courses *Research Communication, Parts 1 and 2*, the JML module in the Ethics course, thesis work and through participation in seminars, which through the specialisation of the subject to a great extent deal with sustainable development.

1.4.2 Compulsory courses

Compulsory third-cycle courses in Environmental Engineering, for both specialisations, are:

- Philosophy of Science and Research Methodology, Engineering and Natural Sciences (7.5 credits)

- Introduction to Research Law and Ethics (1.5 credits)
- Introduction to Gender Equality, Diversity and Equal Opportunities (JML) for PhD Students (0.5 credits)
- Research Communication, Publishing, Presentation and Critical Evaluation, Part 1 for Lic Degree (4.5 credits)
- Research Communication, Publishing, Presentation and Critical Evaluation, Part 2 for PhD Degree (3.0 credits)
- SEED programme-wide seminar course (3.0 credits)

Research Communication, Publishing, Presentation and Critical Evaluation, Part 1 (seminar part, basic course, 1.5 credits) and Research Communication, Publishing, Presentation and Critical Evaluation, Part 2 (seminar part, advanced course, 1.5 credits) are partly replaced by SEED's programme-wide seminar course (3 credits).

The subject specialisations also include specialisation-specific compulsory courses (see headings 4 and 5 respectively).

1.4.3 Recommended courses

Recommended third-cycle courses in Environmental Engineering are:

- Basic Communication and Teaching, 3.0 credits
- Writing Scientific Articles, 5.0 credits

The subject specialisations also include specialisation-specific recommended courses (see headings 4 and 5 respectively).

1.4.4 Conditional elective courses

Conditional electives are described under heading 4, for specialisation Land and Water Resources Engineering. Specialisation Hydraulics and Technical Hydrology has no conditional electives.

1.4.5 Requirements for the degree

Degree of Doctor

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

Thesis

Quality requirements and possible other requirements for the thesis.

A doctoral thesis in Environmental Engineering normally consists of a compilation thesis with 4 or 5 independent articles that are publishable in international scientific journals with a formal review procedure, as well as a summary of the subject area and the doctoral student's contribution to the field (an 'introductory chapter'). Exceptionally, theses may also be presented as a monograph, but with the same requirement of being publishable in international, peer-reviewed scientific journals. The thesis is normally to be written in English.

The introductory chapter of the doctoral thesis must be an original text authored by the doctoral student, which should place the research in a broader scientific context and, where appropriate, in a wider societal context. The introductory chapter must be a self-contained summary or synthesis of the papers included and the doctoral student's contribution to them, possibly requiring some figures to be repeated in the introductory chapter. The introductory chapter of a doctoral thesis which is based on a licentiate thesis may include sections of the introductory chapter to the licentiate thesis, which should, however, be rewritten in order to avoid self-plagiarism. In such cases, it should be made clear that the introductory chapter of the doctoral thesis is based on the introductory chapter of the licentiate thesis. Furthermore, the introductory chapters of such doctoral theses should make clear the progression from the licentiate thesis.

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.

Degree of Licentiate

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

Thesis

Quality requirements and possible other requirements for the licentiate thesis.

The licentiate thesis must normally correspond to two scientific articles publishable in international, peer-reviewed scientific journals. The introductory chapter of the licentiate thesis must be an original text authored by the doctoral student. It must be a self-contained synthesis of the articles included, which may require some figures to be repeated in the introductory chapter.

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

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

Regular meetings between supervisors and doctoral students organise the thesis work, and supervision plays a key role in motivating and providing feedback on doctoral studies and thesis work. Supervision shall support doctoral students to provide them the opportunity to develop their skills towards the applicable intended learning outcomes for the programme, including literature synthesis, scientific inquiry, data collection and processing, analysis, justification of scientific contributions, and communication in various forms and contexts. Supervision also supports doctoral students' achievement of the intended learning outcomes on judgement and approach.

To advance in the salary grades for doctoral student employment, certain objectives must be met. For 30 per cent, a first article must be publishable; for 50 per cent, a successful licentiate or half-time seminar is required; and for 80 per cent, three articles must be publishable.

Within the doctoral programme, the doctoral student is expected to complete a start-up seminar, a half-time or licentiate seminar and a final review, which takes place through participation in SEED's programme-wide seminar course.

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 Environmental Engineerin, the applicant must have passed courses resulting in at least 60 credits at minimum second-cycle level in Physics or other subjects deemed directly relevant to the chosen specialisation. These entry requirements can be 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 Environmental 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 admitted to a previous general syllabus are entitled to follow either the new syllabus or the syllabus under which they were admitted. Requests to adopt a new syllabus are made to the director of third-cycle education.

Doctoral students who have been admitted to a previous study programme in the subjects Land and Water Resources Engineering or Civil and Architectural Engineering with a specialisation in Hydraulics and Technical Hydrology, have the right to switch to the subject Environmental Engineering or continue the study programme to which they have been admitted. When changing to Environmental Engineering, doctoral students can choose between following compulsory course requirements of Environmental Engineering or the previous subject. The choice should be reflected in the first individual study plan following the switch. However, changing syllabi requires that the new syllabus can be achieved in time.

Requests to change to a new syllabus are made to the director of third-cycle education at the school.

4 Environmental Engineering, Land and Water Resources Engineering specialisation

The programme content, admission and other regulations described in sections 1-3 (above) apply to the subject Environmental Engineering, both specialisations. In addition, programme content for the Land and Water Resources Engineering specialisation is described in section 4.1.

4.1 Programme content

4.1.1 Specialisation description

The third-cycle programme includes the study of land and water systems, as well as engineering applications related to land use, water management and construction. Its scientific basis is basic natural science combined with technical knowledge, which may involve an understanding of society's technological infrastructures and the natural environment or their interactions. Natural resources are studied from a societal perspective, with links to social sciences and different cultures' approach to natural resources also playing an important part. Knowledge and methodologies for the conservation and utilisation of natural resources encompass different spatial scales, from small-scale natural processes to entire continents and global phenomena. Research focuses on the requirements of a sustainable society and includes understanding processes, technological development and societal policies. The technologies we develop aim to ensure the sustainable and efficient use of natural resources. The wide range of thesis/dissertation topics, and the collaboration between the different research groups within the department, strengthen the scientific environment and facilitate the interdisciplinary research needed to solve important environmental problems.

4.1.2 Organisation of the education

There is a high degree of flexibility regarding which courses can be included in the education. For each doctoral student, course choices must be planned together with supervisors and documented in the individual study plan. At least one of the conditional elective courses is chosen to examine the core of the research domain.

4.1.3 Activities for fulfilment of outcomes for the education

Activities for fulfilment of outcomes for the education are described under heading 1.4.1.

4.1.4 Compulsory courses

Compulsory courses are listed under the subject Environmental Engineering, heading 1.4.2. See also conditional electives in 4.1.6 for the fulfilment of compulsory knowledge requirements.

4.1.5 Recommended courses

Recommended third-cycle courses for the subject Environmental Engineering are:

- Literature course in Land and Water Resources Engineering, A (3.0 credits)
- Literature course in Land and Water Resources Engineering, B (4.5 credits)
- Literature course in Land and Water Resources Engineering, C (7.5 credits)
- Applied Statistics (7.5 credits)
- Essay in Popular Science (1.5 credits)

4.1.6 Conditional elective courses

Within the specialisation Land and Water Resources Engineering, the following third-cycle courses are conditionally optional, i.e., one of them must be taken as a summative assessment of the subject core.

- Land and Water Systems (7.5 credits)
- Advanced Environmental Dynamics (7.5 credits)
- Wastewater Treatment (7.5 credits)
- Groundwater Chemistry and Environmental Applications (7.5 credits)
- GIS for Environmental Modelling (7.5 credits)
- Environmental Assessment (7.5 credits)
- Environmental Geology (7.5 credits)

4.2 Admission to education at third-cycle level (entry requirements, etc.)

See Heading 2.

4.3 Additional regulations needed

See Heading 3.

5 Environmental Engineering, Hydraulics and Technical Hydrology specialisation

The programme content, admission and other regulations described in sections 1-3 (above) apply to the subject Environmental Engineering, both specialisations. In addition, programme content for the Hydraulics and Technical Hydrology specialisation is described in section 5.1.

5.1 Programme content

5.1.1 Specialisation description

The disciplinary research domain of hydraulics and technical hydrology covers fluid mechanics applied to natural aquatic environments and hydraulic engineering structures, in particular in a disciplinary integration with geomechanics and geochemistry. Engineering applications include the mechanical interaction of water with earth and rock structures, such as embankments and spillways, evaluation of the capacity of ground and surface water resources, flood risk, hydropower regulation and water-quality issues. Research is based on theoretical development of the subject area of hydrology, mathematical modelling studies, field experiments and hydraulic laboratory experiments. Examples of experimental techniques include various types of trace-element research in water bodies.

5.1.2 Organisation of the education

The organisation of the education is described in section 1.4

5.1.3 Activities for fulfilment of outcomes for the education

Activities for fulfilment of outcomes for the education are described in section 1.4.1.

5.1.4 Compulsory courses

For the specialisation Hydraulics and Technical Hydrology, the following courses are compulsory (in addition to those compulsory for the subject, see heading 1.4.2):

- Hydrological Transport Processes (7.5 credits) third cycle

5.1.5 Recommended courses

For the specialisation Hydraulics and Technical Hydrology, the following courses are recommended:

- Transport Phenomena (7.5 credits) third cycle
- Hydrology for Hydropower Purposes (2 credits) third cycle

5.1.6 Requirements for the degree

5.2 Admission to education at third-cycle level (entry requirements, etc.)

See Heading 2.

5.3 Additional regulations needed

See Heading 3.