



# General syllabus for third-cycle studies in the third-cycle subject area Systems Engineering

**Decided by:** The deans jointly.

**Effective from:** 2024-01-01

**Dnr:** BTH-5.1.4-0216-2023

**Note:** This is a translation of the established Swedish-language version of the General Syllabus in the subject. In the event of discrepancies, the Swedish-language version takes precedence.

## **1 Description of the third-cycle subject at BTH**

Systems engineering highlights fundamental questions for how a technical system with many different components can work together to form a functioning whole. Systems engineering is a subject that traditionally has a strong position in Swedish industry. The subject aims to gain a systematic and fundamental understanding of large-scale systems. Systems engineering research is important in a number of areas in our society and makes it possible to transfer ideas from one application area to another. This applies not only to the development of industrial products, but also to infrastructure, transport and health care. In recent years, the availability of low-cost sensors and computer components has contributed to the expansion of the subject. The increasing computational capacity of computers has opened up a number of new applications and at the same time contributed to a more efficient use of resources. Systems engineering meets up where relevant issues are becoming increasingly complex and when there are demands for new theory to handle and analyse larger amounts of information and increased complexity while maintaining demands for precision, flexibility and security.

The systems engineering specialisation at BTH currently includes medical technology, measurement technology, mathematical modelling and optimisation of systems, stochastic processes, automatic control, signal processing, remote sensing, sensor and information systems, marine technology and autonomous vehicles and transport systems.

## **2 Structure of the programme**

Third-cycle studies that conclude with a licentiate degree comprise two years of net study time (120 credits) and consist of a course component of 37–60 credits and a licentiate thesis of 60–83 credits.

Doctoral studies that end with a doctoral degree comprise four years of net study time (240 credits) and consist of a course component of 67–90 credits and a thesis of 150–173 credits.

Doctoral students who have been admitted to a doctoral degree are given the opportunity to obtain a licentiate degree (as above) after a part of at least 120 credits has been completed of the education that is to conclude with a doctoral degree.

An individual study plan is drawn up for each doctoral student<sup>1</sup>. The individual study plan describes the individual structure of the education. The individual study plan is revised and followed up annually in accordance with the routines

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<sup>1</sup> In BTH's general syllabus, the word "doctoral student" is used synonymously with the Higher Education Ordinance "doctoral student" (according to Chapter 1, Section 4 of the Higher Education Ordinance (1993:100)). The choice of words is made to avoid confusion with doctoral studentships and that as a doctoral student, you can be admitted to a licentiate degree and not just a doctoral degree.

established at BTH. The study plan should convincingly demonstrate how the objectives of the doctoral student's doctoral education can be achieved within the available time.

In accordance with the Higher Education Ordinance, at least two supervisors are appointed, one of whom is appointed as principal supervisor. According to the Higher Education Ordinance, an examiner must also be appointed for each doctoral student for assessment and grading of doctoral education. The appointment of supervisors and examiners must be made in accordance with BTH's guidelines. The supervisor, who is not the main supervisor of the two, must have a PhD. In addition, additional supervisors may be attached to the doctoral student, for example from the business sector, if it is of benefit to the doctoral student's studies. For these additional supervisors, there is no requirement to have a PhD.

### **2.1 Purpose of the education**

BTH conducts doctoral education to contribute to solutions to society's complex challenges and meet the demands of a changing labour market.

Specifically, the doctoral education aims to develop the doctoral student's knowledge in the subject area and ability to conduct independent research, development, teaching and investigative work based on a scientific basis in different areas of society. In addition, the purpose of the doctoral degree is to give the doctoral student the ability to critically and independently plan, initiate and lead such work.

### **2.2 Objectives of the programme**

According to the System of Qualifications in the Higher Education Ordinance (1993:100) as set out in the appendix.

### **2.3 Implementation of the education**

The doctoral student conducts research and writes and defends a scientific work (licentiate thesis/doctoral thesis). To support this, the programme may include lectures, seminars, literature studies, project assignments, group supervision and individual supervision. Courses for each individual doctoral student are determined individually in consultation with the supervisors and the examiner and are included in the individual study plan.

The supervision in the programme aims to assist the doctoral student in the choice of research area, scientific method, and the organisation and planning of the scientific work and associated studies. The supervisors shall assist with subject expertise and ensure that the work maintains an international level of quality. The supervision also aims to introduce the doctoral student to the scientific community and its requirements for ethics, integrity, and critical thinking.

The doctoral student will participate in national and international contexts and present his/her own research.

During the study period, the doctoral student will take part in the scientific activity conducted within the research environment at the department/faculty by attending seminars and guest lectures, and normally give one seminar per year on his/her thesis work.

Doctoral students, employed by the university as doctoral students, are recommended to devote some time (no more than 20 percent of full time) to teaching undergraduate education. Such initiatives are funded by undergraduate education and must be described in the individual study plan.

The programme must be designed so that the doctoral student achieves the applicable qualitative targets. How each individual doctoral student's knowledge needs are to be ensured in order to fulfil the qualitative targets is stated in each individual study plan.

### **3 Eligibility and selection**

#### **3.1 General entry requirements**

According to Chapter 7. Section 39 of the Higher Education Ordinance (1993:100).

#### **3.2 Specific entry requirements**

To be eligible for admission to third-cycle studies, the applicant must have been awarded a second-cycle degree in a technical or mathematical-natural sciences field or have acquired knowledge in some other way to be able to benefit from third-cycle studies in the subject.

#### **3.3 Selection**

According to Chapter 7. 41 § in the Higher Education Ordinance (1993:100) and current admission regulations at BTH. Selection shall be made with regard to the applicants' ability to benefit from the programme. The basis for selection among eligible applicants is the degree of ability to benefit from the doctoral education, as well as the availability of supervision and other resources with regard to the planned focus of the licentiate thesis/doctoral thesis.

The assessment criteria applied in the selection process for doctoral studies are:

- Familiarity with the theory and applications of the subject,
- Relevant work experience, if applicable,
- Ability to express oneself in speech and writing,
- Familiarity with English,
- Creativity, initiative, independence, and ability to cooperate.

The basis for assessing the applicant's fulfilment of the assessment criteria is the results of completed university courses, the quality of the independent project and any publications, references, interviews and a personal letter from the applicant describing the applicant's expectations and intentions for the programme. In some cases, the applicant may be required to undergo special work samples.

Admission to doctoral studies takes place continuously.

#### **4 Tests included in the education**

The programme consists of courses and scientific work. Examinations that are part of doctoral studies are assessed with the grade pass/fail. The grade of the course and the licentiate thesis is determined by a specially appointed examiner. The grade of the doctoral thesis is decided by a specially appointed examining committee.

For any credit transfer, please refer to the current credit transfer procedure and guidelines for credit transfer.

#### **4.1 Courses**

To support the research work, and for the fulfilment of the qualitative targets in general, the doctoral student takes a number of courses. Courses completed at BTH as well as other higher education institutions can be included.

For doctoral courses given at BTH, there must be a written course description that states, among other things, the name of the course in Swedish and English, the course objectives, content and credits. The individual study plan must regulate which courses may be included in the programme and how many credits each course is to be counted as (when participating in a course that is originally intended for first- or second-cycle level, please refer to the guidelines for credit transfer of courses in third-cycle education).

Elements of the education in the following areas are compulsory. How these are examined, through a course or other element, is regulated in each individual study plan.

- Research Methodology
- Information retrieval for researchers
- Scientific writing and review
- Ethics in research

The choice of courses shall be characterized by flexibility with regard to the doctoral student's prior knowledge and the focus of the research work and shall be determined in consultation between the doctoral student, supervisor and examiner. The form of examination is determined by the examiner in consultation with the supervisor. Goal fulfilment is assessed by the examiner.

All compulsory courses or components must be completed before the doctoral thesis is orally defended at a public defence. Other courses and modules should be chosen so that the doctoral student has both breadth and depth within the research area. The courses should also benefit the doctoral student's skills and abilities, his or her studies or scientific work.

#### **4.2 Scientific work**

Scientific work in the form of a licentiate thesis/doctoral thesis shall be designed as a coherent, scientific work (monograph) or as a summary and associated scientific papers (compilation), which the doctoral student(s) have authored alone or jointly with another person. The scientific work is written in English or Swedish.

The licentiate thesis must be defended orally at a public licentiate seminar. For further information, please refer to the "Rules for licentiate seminars" established by the university.

The doctoral thesis must be defended orally at a public defence. The thesis must have previously been quality assured as described in "Appendix – Quality assurance of doctoral thesis". For further information, please refer to the "Rules for public defences" established by the university.

### **5 Degree**

#### **5.1 Qualitative targets**

Objectives according to the System of Qualifications in the Higher Education Ordinance (1993:100), "Appendix - System of Qualifications (Higher Education Ordinance (1993:100))".

In addition to the objectives of the System of Qualifications in the Higher Education Ordinance, the doctoral student must demonstrate knowledge of gender equality issues in research.

#### **5.2 Title of qualification**

The title of the doctoral degree at BTH consists of a general degree with the addition of a prefix.

A doctoral student who is pursuing a licentiate degree in the subject and who has a technical qualification is<sup>2</sup> normally awarded the title of Degree of Licentiate. In other cases, the title of the degree is Degree of Licentiate.

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<sup>2</sup> In this context, technical education refers to a Master of Science in Engineering, a Degree of Master of Science or equivalent in a technical or mathematical-natural sciences field.



A doctoral student who is pursuing a doctoral degree in the subject and who has a technical qualification is normally awarded the title of Doctor of Philosophy. In other cases, the title of the degree is Doctor of Philosophy.

The prefix must be clarified in the individual study plan.

### **6 Entry into force and transitional provisions**

This general syllabus enters into force on 1 January 2024.

As a general rule, doctoral students admitted before this date complete their studies according to an older study plan. If a doctoral student so wishes and it is deemed appropriate, the examiner concerned may approve the transition to a new general syllabus. The doctoral student must then notify the relevant dean of the transition and attach a copy of an individual study plan updated according to the new general syllabus.

## Appendix - Quality assurance of doctoral thesis

### **Pre-assessment of doctoral thesis in the third-cycle subject area of *Systems Engineering* at BTH**

Pre-assessment of a doctoral thesis in the third-cycle subject area of *Systems Engineering* at BTH means that ordinary members of the examining committee shall each assess whether the thesis is of sufficient quality to be considered suitable to be presented and defended at a public defence. If this is considered to be the case, the review does not need to be followed by any reasoning or commentary. If this is not considered to be the case, the judgement must be justified. A positive pre-assessment is only advisory and does not preclude another assessment after the public defence.

The process is as follows:

1. The pre-assessment should be completed no later than seven weeks before the public defence. The preliminary assessment should not take more than two weeks and the thesis (in a close final version) should therefore be sent to the members of the examining committee no later than nine weeks before the public defence.
2. If a member of the examining committee is replaced after the preliminary assessment has been completed, the substitute does not need to pre-assess the thesis.
3. A review is sent in the form of a completed pre-assessment form (attached) by e-mail to the principal supervisor. If a grader does not respond, despite a reminder, it is interpreted as a positive review. The principal supervisor informs the dean of the results of the preliminary assessment.
4. If all reviews in the pre-assessment are positive, the process will continue according to plan. If one or more assessors consider that the thesis is not of sufficient quality, the public defence should be postponed. However, the doctoral student has the right to present the thesis for public defence according to the original plan.

The principal supervisor is responsible for ensuring that the pre-assessment is carried out in accordance with these guidelines.





Form for pre-assessment of doctoral thesis in the third-cycle subject area of Systems Engineering at BTH

**Doctoral student's name**

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**Preliminary title of the thesis**

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**Opinion**

I believe that the thesis is of sufficient quality to be considered suitable for presentation and defence at a public defence

I do not consider the thesis to be of sufficient quality to be considered suitable for presentation and defence at a public defence

*In case of a negative assessment, please justify below or in the attached letter.*

**Justification:**

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**Signature**

**Place and date:**

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**Signature:**

**Name in block letters:**

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## Appendix - System of Qualifications (Higher Education Ordinance (1993:100))

### **Licentiate degree**

#### **Extent**

A licentiate degree is awarded

either after the doctoral student has completed a course of study of at least 120 credits in a subject for third-cycle studies,

or after the doctoral student has completed a part of at least 120 credits of a course of study that is to conclude with a doctoral degree, if the higher education institution decides that such a licentiate degree can be awarded at the higher education institution.

#### **Target**

##### **Knowledge and understanding**

For a licentiate degree, the doctoral student must

- demonstrate knowledge and understanding in the field of research, including current specialist knowledge in a limited part of this area as well as specialised knowledge of scientific methodology in general and the methods of the specific research area in particular.

##### **Competence and skills**

For a licentiate degree, the doctoral student must

- demonstrate the ability to identify and formulate issues critically, autonomously and creatively and with scientific accuracy, and to plan and, using appropriate methods, carry out a limited research project and other advanced tasks within predetermined time frames and thereby contribute to the formation of knowledge and to evaluate this work,

- demonstrate the ability to present and discuss, orally and in writing, research and research results in both national and international contexts in dialogue with the scientific community and society in general, and

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

##### **Judgement and approach**

For a licentiate degree, the doctoral student must

- demonstrate the ability to make assessments of research ethics in their own research,
- demonstrate insight into the possibilities and limitations of science, its role in society and the responsibility of the individual for how it is used, and
- demonstrate the ability to identify his or her need for further knowledge and to take responsibility for his or her knowledge development.

### **Scientific paper**

For a licentiate degree, the doctoral student must have had a scientific thesis of at least 60 credits approved.

### **Other**

For a licentiate degree with a certain specialisation, the specified requirements that each higher education institution itself determines within the framework of the requirements in this qualification descriptor shall also apply.

### **Phd**

#### **Extent**

A doctoral degree is awarded after the doctoral student has completed a course of study of 240 credits in a subject for third-cycle studies.

#### **Target**

#### **Knowledge and understanding**

For a doctoral degree, the doctoral student shall:

- demonstrate broad knowledge and a systematic understanding of the research area as well as in-depth and up-to-date specialist knowledge in a defined part of the research area, and
- demonstrate familiarity with scientific methodology in general and with the methods of the specific research area in particular.

#### **Competence and skills**

For a doctoral degree, the doctoral student shall:

- demonstrate the ability to conduct scientific analysis and synthesis as well as to independently critically examine and assess new and complex phenomena, issues and situations,

- demonstrate the ability to identify and formulate issues critically, independently, creatively and with scientific accuracy, and to plan and, using appropriate methods, conduct research and other advanced tasks within predetermined time frames, and to review and evaluate such work,
- demonstrate by means of a thesis the ability to make a significant contribution to the formation of knowledge through their own research,
- demonstrate the ability to present and discuss research and research results in both national and international contexts, orally and in writing, in dialogue with the scientific community and society in general,
- demonstrate the ability to identify the need for further knowledge, and
- demonstrate the ability to contribute to the development of society and support the learning of others, both in research and education as well as in other qualified professional contexts.

### **Judgement and approach**

For a doctoral degree, the doctoral student shall:

- demonstrate intellectual independence and scientific probity as well as the ability to make assessments of research ethics, and
- demonstrate in-depth insight into the possibilities and limitations of science, its role in society and the responsibility of the individual for how it is used.

### **Scientific dissertation (doctoral thesis)**

For a doctoral degree, the doctoral student must have received a passing grade for a scientific thesis (doctoral thesis) of at least 120 credits.

### **Other**

For a doctoral degree with a certain specialisation, the specified requirements that each higher education institution itself determines within the framework of the requirements in this qualification descriptor shall also apply.