



# General syllabus for third-cycle courses and study programmes for the third-cycle subject area Applied Signal Processing

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

In the subject area of Applied Signal Processing at BTH, application is a cohesive overall direction. Signal processing is often defined as the processing of signals, information-bearing entities, and we use for instance optical, acoustic, electrical and chemical signals on a daily basis. Often signals are converted from one form to another in order to facilitate human interpretation, for information extraction and interpretation in a wider sense.

The subject area of Applied Signal Processing at BTH includes analysis of and methods for reducing the impact of interference, noise, vibration and noise pollution in signals to extract information from signals and to classify the signals. Development of algorithms and techniques for estimation and communication of forms of signals or signal parameters is often the basis.

Implementation of new algorithms, as well as industrial application of new methods, innovations, and the production of products is our focus in the subject area. Product applies to; physical artefacts, software, processes, services or combinations of these.

Advanced IT tools, for example modelling, simulation, visualization, optimization, data management and distributed engineering is characteristic of the research.

Examples of special areas currently being studied at BTH and used for product enhancements are complex vibro-acoustic systems, navigation and communication systems, multimedia applications and classification.

## **2 Structure of the course/programme**

Third-cycle courses and study programmes which finish with a Degree of Licentiate comprise an actual period of study of two years (120 higher education credits) and consist of a course component of 40 – 60 higher education credits and a licentiate thesis of 60 – 80 higher education credits.

Third-cycle courses and study programmes which finish with a Degree of Doctor comprise an actual period of study of four years (240 higher education credits) and consist of a course component of 70 – 90 higher education credits and a dissertation of 150 - 170 higher education credits.

A third-cycle student who is admitted to the Degree of Doctor is given the possibility to take a Degree of Licentiate (according to the above) after having completed minimum 120 higher education credits of the programme that is to be finished with a Degree of Doctor.



For each third-cycle student an individual study plan is set up. The individual study plan describes the individual set-up of the studies. The individual study plan is revised and followed up yearly in accordance with the routines that are established at BTH. The study plan is to show in a convincing way how the goals for the third-cycle student's studies can be attained within the available time period.

In accordance with the Higher Education Ordinance at least two supervisors are appointed for each third-cycle student of whom one is appointed principal supervisor. According to the BTH local guidelines for the appointing of principal supervisor she/he is to be professor, adjunct professor or docent employed at BTH and is to have undergone supervisor training or hold the equivalent competence. A supervisor, who is not the principal supervisor of the two, is to have a doctoral degree. In addition, further supervisors may be affiliated to the third-cycle student, e.g., from the business sector, if this is for the benefit of the third-cycle student's studies. For these additional supervisors no demand on having a doctoral degree is placed.

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

BTH conducts third-cycle education in order to contribute with solutions to the complex challenges in society and to meet the demands of a changeable labour market.

Specifically, the third-cycle courses and study programmes aim at developing the third-cycle student's knowledge in the subject area and her/his capacity to independently carry on research-, development-, teaching- and investigatory work based on a scientific foundation in different areas of society. The purpose of the Degree of Doctor is, in addition, to give the third-cycle student the capacity to critically and independently plan, initiate, and lead such work.

Specifically the third-cycle studies in Applied Signal Processing aims to give the third-cycle student deep knowledge and deep analytical skills in the subject area and the ability to conduct independent research and education. After the doctoral degree, the postgraduates have the ability to initiate and lead such activities.

### **2.2 Goals for the education**

According to the System of Qualifications in the Higher Education Ordinance (1993:100) according to enclosure.

### **2.3 Realization of the education**

The third-cycle student carries on research and writes a scientific work (licentiate thesis/doctoral dissertation). In support of this, the education may include lectures, seminars, literature studies, project assignments, group supervision and individual supervision. Courses for each third-cycle student are established individually in consultation with the supervisors and the examiner and are entered into the individual study plan.

The supervision of the education aims at assisting the third-cycle student regarding choice of research domain, scientific method and organization and planning of the scientific work and pertaining studies. The supervisors are to assist with subject competence and see to that the work holds an international quality level. Furthermore, the supervision aims at introducing the



third-cycle student to the scientific community and its demands on ethics, honesty and critical thinking.

The third-cycle student is to participate in national and international contexts and present her/his own research.

During the education period the third-cycle student is to take part of the scientific activities which are conducted in the scientific environment at the department/faculty by attending seminars and guest lectures, and, in the normal case, give one seminar per year about her/his thesis work.

The third-cycle student is to carry out a popular science-based presentation of her/his research before the Degree of Licentiate and public defence of the doctoral dissertation and write a popular science-based summary which is to be included in the licentiate thesis respective the doctoral dissertation.

A third-cycle student, employed by the higher education institution as a doctoral student, is recommended to dedicate certain time (not more than 20 per cent of full working hours) to teaching in first- and second-cycle courses and programmes. Such work is financed by the first- and second-cycle courses and programmes and is to be accounted for in the individual study plan.

The education should be organized so that the third-cycle student attains the stipulated examination targets. How the knowledge needs of each individual third-cycle student are to be fulfilled in order to attain the examination targets is stated in respective individual study plan.

### **3 Entry requirements and selection**

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

According to 7 Chap. 39 § in the Higher Education Ordinance (1993:100).

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

Qualified for entry to third-cycle education is she/he who has taken a second-cycle qualification in the fields of engineering or mathematics-sciences or who in some other way has acquired knowledge to be able to profit by the third-cycle studies of the subject.

#### **3.3 Selection**

According to 7 Chap. 41 § in the Higher Education Ordinance (1993:100) and the current admission regulations at BTH. Selection is to be made in consideration of the applicants' capacity to profit by the education. The foundation for selection among the qualified applicants is the degree of capacity to profit by the third-cycle education, and the access to supervision and other resources in view of the planned specialization of the licentiate thesis/doctoral dissertation.

The bases of assessment applied at the selection for third-cycle education are constituted by:



- Familiarity with the theory and applications of the subject,
- Relevant work experience where appropriate,
- Skills in expression of speech and in writing,
- Familiarity with English,
- Creativity, capacity for initiative, independence and ability to co-operate.

To assess how the applicant fulfils the bases of assessment results are used that show passed higher education courses, quality of the independent work and possible publications, references, interviews together with a personal letter from the applicant which describes the applicant's expectations on and intentions with the education. In certain cases the applicant may undergo specific work tests.

Admission to third-cycle education is done on a continuous basis.

#### **4 Examinations that form part of the education**

The education consists of courses and a scientific work. Examinations that form part of the third-cycle education are assessed with the grades pass/failed. A grade on a course and a licentiate thesis, respectively, is determined by a specially appointed examiner. A grade on a doctoral dissertation is determined by a specially appointed grading committee.

For a possible credit transfer, see the current order for credit transfers and the guidelines for credit transfers for first-cycle and second-cycle education.

##### **4.1 Courses**

In support of the research work and for the fulfilment of the examination targets generally, the third-cycle student takes a number of courses. Courses completed at BTH as well as courses from other higher education institutions can be included.

For third-cycle courses given at BTH there is to be a written course description which, among other things, states the title of the course in Swedish and English, the course objectives, content and credits. The individual study plan is to regulate which courses can form part of the studies and how many higher education credits each course should award (for participation in a course originally intended for first- or second-cycle see the guidelines for credit transfer of courses in third-cycle education).

In accordance with the BTH program and action plan for quality work, the third-cycle student who within the framework of the employment is expected to teach is to take the first part (3 higher education credits) of the introductory course in teaching and learning in higher education (7.5 higher education credits).

Components of the education in the areas below are compulsory. How these are examined, through a course or other component, is regulated in each separate individual study plan.

- Research methodology
- Information search for researchers
- Scientific writing and scientific review
- Ethics in research



The main aim of the courses is to be a support for the thesis and to otherwise achieve the objectives of the third-cycle studies as described above. Thus, the majority of the courses should be advanced courses in the subject area. The teaching in this type of courses is also done in the form of guided self-studies and seminars. Courses or parts of courses from first- or second-cycle education can also be included, should the third-cycle student need to complement his/her previous knowledge.

The choice of courses is to be characterized by flexibility with regard to the third-cycle student's prior knowledge and the specialization of the research work and is to be determined in consultation between the third-cycle student, supervisors and examiner. The examination format is determined by the examiner in consultation with the supervisors. Goal attainment is tested by the examiner.

All compulsory courses or components are to be completed before the doctoral dissertation is publicly defended at the public defense of the doctoral dissertation. Other courses and components are to be chosen so that the third-cycle student obtains both breadth and depth in the research domain. The courses are also to benefit the third-cycle student's competence and skills, her/his studies or scientific work.

#### **4.2 Scientific work**

Scientific work in the form of a licentiate thesis/doctoral dissertation is to be designed as an integrated, connected scientific work (monograph) or as a summary – introductory chapter – together with pertaining scientific academic papers (compilation), which the third-cycle student has written alone or together with another person. The scientific work is written in English or Swedish.

The licentiate thesis is to be defended orally at a public licentiate seminar. For further information please see "Regulations for licentiate seminars" established by BTH.

The doctoral dissertation is to be defended orally at a public defence of doctoral dissertation. For further information please see "Regulations for the public defence of a doctoral dissertation" established by BTH.

### **5 Degree**

#### **5.1 Examination targets**

Goals according to the System of Qualifications in the Higher Education Ordinance (1993:100) according to enclosure.

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

The degree title of third-cycle studies in Swedish at BTH consists of a general degree with the addition of a prefix. The prefix is normally teknologie (Technology).

Third-cycle students studying for a Degree of Licentiate in Applied Signal Processing normally receives the Swedish degree title teknologie licentiatexamen (Eng. Degree of



Licentiate of Technology).

Third-cycle students studying for a Degree of Doctor in Applied Signal Processing normally receives the Swedish degree title teknologie doktorsexamen (Eng. Degree of Doctor of Philosophy).

Exceptions to the prefix Technology in the Swedish degree: For individuals who do not have a second-cycle technical education<sup>1</sup> a degree of Philosophy will be awarded. The prefix should be clarified in the individual study plan. For a degree of Philosophy the Swedish degree title is:

Filosofie licentiatexamen (Eng. Degree of Licentiate of Philosophy).

Filosofie doktorsexamen (Eng. Degree of Doctor of Philosophy).

### **6 Effective date and interim regulations**

This general syllabus becomes effective on July 1 2016.

Third-cycle students admitted before July 1 2016 will complete, as a general rule, their studies according to the older general syllabus. If a third-cycle student so requests and it is deemed suitable, the relevant examiner may accept a transfer to the new general syllabus. The third-cycle student will then report the transfer to the relevant Dean and attach a copy of an updated individual study plan updated according to the new general syllabus.

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<sup>1</sup> A technical education refers to a Master's degree in Engineering, Master's degree in Science or equivalent in a technical or mathematical-scientific field.



## **ANNEX**

### **General qualifications**

#### **Degree of Licentiate [Licentiatexamen]**

##### **Scope**

A Degree of Licentiate is awarded

either after a third-cycle student has completed a study programme of at least 120 credits in a subject in which third-cycle teaching is offered,

or after a third-cycle student has completed one part comprising at least 120 credits of a study programme intended to conclude with the award of a PhD, if a higher education institution decides that a Degree of Licentiate of this kind may be awarded at the institution.

##### **Outcomes**

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

For a Degree of Licentiate the third-cycle student shall demonstrate knowledge and understanding in the field of research including current specialist knowledge in a limited area of this field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.

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

For a Degree of Licentiate the third-cycle 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
- demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and society in general, and
- demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.

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

For a Degree of Licentiate the third-cycle student shall

- demonstrate the ability to make assessments of ethical aspects of his or her own research
- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and



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

### **Thesis**

For a Degree of Licentiate the third-cycle student shall have been awarded a pass grade for a research thesis of at least 60 credits.

### **Miscellaneous**

Specific requirements determined by each higher education institution itself within the parameters of the requirements laid down in this qualification descriptor shall also apply for a Degree of Licentiate with a defined specialisation.

### **Degree of Doctor**

#### **Scope**

A Degree of Doctor is awarded after the third-cycle student has completed a study programme of 240 credits in a subject in which third-cycle teaching is offered.

#### **Outcomes**

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

For the Degree of Doctor the third-cycle student shall

- demonstrate broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and
- demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.

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

For the Degree of Doctor the third-cycle 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
- 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
- demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research



- 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
- demonstrate the ability to identify the need for further knowledge and
- 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.

### **Judgement and approach**

For the Degree of Doctor the third-cycle student shall

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

### **Research thesis (doctoral thesis)**

For the Degree of Doctor the third-cycle student shall have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

### **Miscellaneous**

Specific requirements determined by each higher education institution itself within the parameters of the requirements laid down in this qualification descriptor shall also apply for a Degree of Doctor with a defined specialisation.