



HÖGSKOLAN
DALARNA

General Syllabus for the Doctoral Programme in Energy Systems in the Built Environment in the Field of Resource Efficient Built Environment

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1. Description of Subject

The third-cycle subject area *Energy Systems in the Built Environment* belongs to the academic field *Resource Efficient Built Environment*. This third-cycle subject area includes that part of the subject that deals with energy systems with application (primarily) in the built environment. Doctoral studies in the subject are about technical energy solutions at different system levels where energy use in buildings has a central role in system design. In addition to energy technology solutions, the concept of energy includes efficient energy use from a resource perspective on raw material use (primary energy) and environmental impact (for example, local and global emissions). Energy as a resource in buildings is seen from a life-cycle perspective in the design of energy system solutions that are sustainable in the long term. The impact of energy systems on the indoor climate in a building can be an important study component. In the research subject, the emphasis is on energy technology installations located in the built environment, which includes solar energy installations, installations for heating/cooling and electricity, and energy transfer in local distribution networks. The subject has a special profile in solar energy technology solutions integrated into the energy systems of buildings.

Built environment refers to construction in the form of residential buildings and premises but can in certain special applications refer to industry and energy facilities where the subject profile and knowledge within the research area can be applied. This may apply to, for example, energy solutions for process heating/cooling.

Methodologically, the third-cycle subject area includes studies that are empirical and theoretical. Experimental research studies involve small-scale systems that are built up in the university laboratories to study various system solutions, including control and regulation solutions for an optimal energy and power balance between the supply of renewable energy and energy use. Studies can also take place in case study form (housing/premises for renovation and new constructions) where different solutions can be studied in real life (living labs) and where measurement data and other forms of data are analysed. Empirical data is combined with theory focused on model development where simulation of different system solutions contributes with a higher degree of generalisability in the research. At a higher system level, districts and cities, empirical data collected from energy companies/housing companies is used for energy mapping of larger areas and model building at the local (neighbourhood), district or city level to study different scenarios for sustainable urban planning. In these studies, large amounts of data (in time and space) are processed and handled, and the doctoral studies focus on model development where a number of computational tools are combined to study complex systems at different levels of detail.

In addition to energy, the research area *Resource Efficient Built Environment* includes research on resources, materials and the environment in the built environment: resource-efficient use of materials in construction, operation and demolition, healthy indoor climates, and low environmental impact from a life-cycle perspective on construction. In addition to buildings, central to the concept of a built environment are spatial structures with infrastructure and functions for people's lives and activities in an area, with a basis in research on spatial planning. The research area as a whole aims to build knowledge so as to develop sustainable civil planning and construction and therefore has an interdisciplinary character where doctoral studies can include elements of a sociotechnical or techno-economic nature in projects in collaboration with social planners, social scientists and economists.

Upon completion of their education, students are awarded a Degree of Doctor/Degree of Licentiate in the third-cycle subject *Energy Systems in the Built Environment* in the field *Resource Efficient Built Environment*.

2. Learning Outcomes for Doctoral Programmes

2.1 General Learning Outcomes

In accordance with the System of Qualifications, Annex 2, Higher Education Ordinance (1993:100), the outcomes of the programme are as follows:

Degree of Doctor

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.

Degree of Licentiate

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.

3. Admission to the Programme

3.1 General

Admission is to either the Degree of Licentiate (120 credits) or the Degree of Doctor (240 credits). A condition for admission to doctoral studies is that the applicant has either been offered a doctoral position at Dalarna University or holds another position that allows them to undertake doctoral studies.

Doctoral positions are advertised nationally and can also be advertised internationally. Admission is on a competitive basis.

3.2 Qualifications

To be admitted to the doctoral programme *Energy Systems in the Built Environment* in the field *Resource Efficient Built Environment*, the applicant must meet the general entry requirements and specific entry requirements and as such have what it takes to benefit from the programme.

General Entry Requirements

To be admitted to doctoral studies, the applicant must have

1. completed a second-cycle degree (Master's),
2. successfully completed courses amounting to at least 240 credits, of which at least 60 credits are at the second-cycle level (Master's), or
3. in some other way, in either Sweden or another country, gained equivalent knowledge.

Specific Entry Requirements

To be admitted to the doctoral programme *Energy Systems in the Built Environment* in the field *Resource Efficient Built Environment*, applicants must have:

1. completed a degree at the second-cycle (Master's) level in engineering or the natural sciences with energy as a central subject and with relevance to the field *Resource Efficient Built Environment*, or equivalent knowledge,
2. received a passing grade for their degree project at the advanced (Master's) level within the degree as stated in point 1. above, and
3. good oral and written communication skills in English.

3.3 Selection

Following a decision by the Head of School (*prefekt*) to advertise the doctoral position, a supervisor group and the line manager prepare an employment profile. The Director of Studies (*studierektor*) has a central role in the design of the employment profile and the selection process. If there is already an intended Principal Supervisor (*huvudhandledare*), then that person is key to the design of the profile and consults with the Director of Studies, Head of Subject (*ämnesföreläsare*) and line manager before the advertisement is published. The advertisement clarifies the specific qualifications required of the doctoral student in the case in question.

Selection among applicants who meet the entry requirements must be made by taking into account their ability to benefit from the doctoral education and must be based on the following assessment criteria:

- previous study results with special emphasis on the quality of degree projects at the second-cycle (Master's) level
- personal suitability to work in an academic environment both with others and independently, and to work in a manner that is structured, long-term and goal-oriented
- ability to communicate in both spoken and written English
- other qualifications and competencies of relevance to the employment profile

Upon admission of doctoral students who hold employment at another organisation, the same assessment criteria apply.

Eligibility and suitability testing is carried out by a recruitment group made up of the Director of Studies (*studierektor*) for the doctoral programme and the intended Principal Supervisor and/or other appointed researchers from the research environment, as well as the line manager. The testing includes interviews with the applicants who have been deemed most suitable. They may also complete a writing assignment to demonstrate their academic knowledge and their ability to benefit from doctoral studies. Based on the determination made by the recruitment group, the Head of School (*prefekt*) makes the formal decision as to which candidate is to be offered the place in the programme and, where applicable, employment.

The candidate who is offered and accepts the advertised doctoral position will in the next step – and before employment takes effect – apply to the doctoral programme. Decisions on admission are made by the Head of School (*prefekt*). Before any decision on admission is made, the following must be assessed:

1. feasibility of the proposed project and its relevance to the third-cycle subject area;
2. financial plan; and
3. the availability of sufficient supervisor competence so that sound, professional supervision can be provided.

3.4 Supervision

At least two supervisors must be appointed for each doctoral student. One of the supervisors is appointed as the Principal Supervisor and must be either docent or professor. The Assistant Supervisor (*biträdande handledare*) must hold a doctoral degree. At least one of the supervisors must be employed at Dalarna University. All supervisors must have completed supervisor training or present a plan for the completion of such training. After preparation by the Director of Studies (*studierektor*), the Head of School (*prefekt*) appoints a preliminary Principal Supervisor (*huvudhandledare*) at the time of admission. At the point when the individual study plan is established, the Principal Supervisor is formally appointed. The Assistant Supervisor (*biträdande handledare*) is appointed when the individual study plan is established, which must take place no later than three months after the decided start date. A change of supervisor can take place whenever the doctoral student or supervisor initiates this. Any time when a supervisor changes, it is the Head of School (*prefekt*) who makes the decision after preparation by the Director of Studies (*studierektor*). Doctoral students are entitled to supervision of 128 hours per year at a 100% rate of activity. The number of hours of supervision is reduced proportionally when there is a lower rate of activity.

4. Programme Description

4.1 General

The Degree of Doctor has a course component comprising 45 credits, of which 20 credits are for compulsory courses and 25 credits are for elective courses, and a dissertation component comprising 195 credits. This results in a total of 240 credits. The Degree of Licentiate has a course component comprising 25 credits, of which 20 credits are for compulsory courses and 5 credits are for elective courses, as well as a thesis component comprising 95 credits. This results in a total of 120 credits. A person may be employed as a doctoral student for a total of no more than eight years; however, the total period of employment may not be longer than what corresponds to full-time doctoral education over four years. This may be extended if special reasons exist (for example, sick leave, service in the armed forces, positions in trade unions and parental leave). The doctoral student may be involved in teaching and perform departmental duties to a maximum of 20% of their total study time and must be compensated with a corresponding extension of study time.

4.2 Individual Study Plan and Financial Plan

An individual study plan that describes the structure of the programme is drawn up preferably soon after the admission of the student and no later than three months after admission. The individual study plan is designed jointly by the doctoral student and supervisor, and must clarify the responsibilities of all parties, both the specific goals for the doctoral student and the scope of the supervision, and must provide a timetable for the doctoral student's education. The individual study plan must include:

1. the names of the Principal Supervisor and Assistant Supervisor
2. the name of the person responsible for credit transfer of course components/modules
3. a description of how supervision will be organised
4. a preliminary title of the thesis, a description of the planned academic work, and a timetable for the doctoral student's doctoral studies
5. a research ethics review
6. a plan showing which doctoral courses are to be included and a record of completed courses
7. a report of the amount of departmental duties/other positions
8. a description of other academic work, such as participation in seminars, conferences and research stays at other higher education institutions
9. a financial plan with details of existing agreements with employers other than Dalarna University

The individual study plan is drawn up on a special form by, jointly, the doctoral student and the Principal Supervisor. It is then reviewed by the Director of Studies (*studierektor*), after which it is put for approval to the Head of School (*prefekt*). A financial plan that clarifies the financial responsibility for the doctoral student's entire doctoral education period is to be attached to the doctoral programme application. In cases where financing is to take place within the framework of employment with another employer, the head of the department where the doctoral student has employment must approve the entire study plan in a specially drawn-up agreement between the employer and Dalarna University as a way to certify that the programmes can proceed as described.

The individual study plan is to be given follow-up and be reviewed annually unless otherwise stated in the individual study plan, and it is to be sent to the Director of Studies (*studierektor*) who ensures follow-up, electronic registration (*diarieföring*) and reporting. Follow-up can be more often than once a year if requested by those responsible for the doctoral programme – i.e., Director of Studies, Head of School (*prefekt*) or the Doctoral Programmes Board (*Forskarutbildningsnämnden*). Established and revised individual study plans and completed credits are documented and archived.

Significant deviations from the individual study plan may result in the doctoral student not having access

to university resources. This is outlined in the Higher Education Ordinance. At the annual review, the Principal Supervisor must assess whether the doctoral student is following the individual study plan.

If the Principal Supervisor deems that a deviation is significant, then the Director of Studies (*studierektor*) for the programme must allow the doctoral student the opportunity to address in writing the supervisor's report and then report to the Head of School. If the Head of School decides there is reason to withdraw resources, then the matter must be handed to the Vice-Chancellor (*rektor*) for a decision. Resources may not be withdrawn for the time when the doctoral student is employed as a doctoral student.

Mid-Way Review

A mid-way review (*halvtidsseminarium*) will be held after the doctoral student has reached about half their study time in the programme. The purpose is to review the work to date and the plan for continuation until the time of the defence (*disputation*). At the seminar, an external reviewer discusses the completed thesis work and the plan for continued studies with the doctoral student. The licentiate seminar is instead of a mid-way review in those cases where the degree of licentiate is part of the education towards a degree of doctor.

4.3 Doctoral Dissertation and Licentiate Thesis

The design of the doctoral dissertation is such that it has several academic articles with a framework report that is normally written in English or in some cases in Swedish. The doctoral dissertation should be made up of at least four academic papers; however, it is the academic quality and the independent contributions of the doctoral student to the development of knowledge that are assessed, not just the number of articles in the dissertation. The doctoral student should be the first author of at least three articles. At least three should have been either published or accepted for publication in an international scholarly journal with peer review.

The design of the licentiate thesis is such that it has two academic articles with a short framework report that also serves as an introduction to the subject of the thesis. The doctoral student should be the first author of at least one article. At least one should have been accepted for publication or have been published in an international scholarly journal with peer review. In some cases, the licentiate thesis can also be designed as a monograph.

A selection of the academic articles in a compilation thesis and the framework report in the thesis should have been discussed at seminars on a continuous basis during the doctoral programme within the framework for the Doctoral Seminar course. Articles consisting of conference papers should have been presented at a conference by the doctoral student.

After suggestions by the Principal Supervisor and after a check to ensure there is no conflict of interest, the Director of Studies (*studierektor*) puts forward the names of a chairperson, an examining committee (*betygsnämnd*), a substitute in the examining committee and an opponent for the defence (*disputation*) for the Doctoral Programmes Board (*Forskarutbildningsnämnden*), who then decide on the defence. The chairperson and the three members of the examining committee must be docents or professors, and the opponent must have at least a degree of doctor. Only one of the regular grading committee members may be a Dalarna University employee. Published/accepted articles and all manuscripts included in the thesis must undergo a preliminary review by the intended examining committee before a decision on defence is made. The members of the examining committee should individually state whether they think that the articles meet the scope and quality that correspond to the knowledge outcomes of four years of full-time study. The examining committee issues an overall recommendation in writing to the Director of Studies. A positive statement at the preliminary review stage does not mean that the thesis will receive a grade of pass at the defence. The response from the review is determined by whether or not the academic work of the doctoral student is deemed to be of such quality and scope that it can be presented in a public defence.

The Doctoral Programmes Board (*Forskarutbildningsnämnden*) decides on the time, place, chairperson, opponent, examining committee members and substitutes for the defence (*disputation*) no later than three months before the defence is to take place. The matter is prepared by the Director of Studies (*studierektor*) following a proposal from the Principal Supervisor.

Prior to the licentiate seminar, the Doctoral Programmes Board (*Forskarutbildningsnämnden*), following a proposal from the Principal Supervisor and preparation by the Director of Studies (*studierektor*), appoints an external opponent, examiner and chairperson, and decides on the date of the seminar. The external opponent must have at least a doctoral degree. The chairperson and examiner must be at least docents. Decisions must be made at least three weeks before the seminar is to be held.

4.4 Courses

Courses are given by Dalarna University or other higher education institutions. There must be a written syllabus where the course outcomes and content are stated. Courses included in the doctoral programme should be specified in the individual study plan. The courses are divided into compulsory courses and elective courses.

Degree of Doctor

The degree of doctor consists of a course component comprising 45 credits, of which 20 credits are compulsory courses.

Compulsory courses:

- General Principles of Scientific Work: Introductory Course, 7.5 credits
- Science Communication, 4.5 credits
- Energy and Resource Use in the Built Environment Part 1, 5 credits
- Doctoral Seminar Course, 3 credits

Elective courses are selected based on the needs of the doctoral student and the specialisation.

Degree of Licentiate

The degree of licentiate consists of a course component comprising 25 credits, of which 20 credits are compulsory courses.

Compulsory courses include:

- General Principles of Scientific Work: Introductory Course, 7.5 credits
- Science Communication, 4.5 credits
- Energy and Resource Use in the Built Environment Part 1, 5 credits
- Doctoral Seminar Course, 3 credits

Elective courses are selected based on the needs of the doctoral student and the specialisation.

5. Degree Requirements

Doctoral studies conclude with a public defence/licentiate seminar. For the degree, the doctoral student must receive a passing grade on the courses included in their programme as well as on the doctoral dissertation/licentiate thesis. The Doctoral Programme Coordinator (*forskarutbildningssamordnare*) checks that the course requirement is met for a degree of doctor/degree of licentiate. The Director of Studies certifies that the student has completed all the courses.

Degree of Doctor

A degree of doctor requires 240 credits, of which 45 credits are obtained in the course part and the remaining 195 credits are for a doctoral dissertation. At the time of applying for the defence (*disputation*), the doctoral student must have published at least two articles in an academic journal with peer review or

have one article accepted for publication in an academic journal with peer review. The thesis must be defended orally in English or Swedish at a public defence led by a chairperson and with the participation of an opponent, with assessment by an examining committee. The doctoral dissertation is awarded either the grade of fail (*underkänd*) or pass (*godkänd*). When a grade is being set, the content of the dissertation and the defence must be taken into account.

Degree of Licentiate

A degree of licentiate requires 120 credits of which 25 credits are obtained in the course component and the remaining 95 credits are for a licentiate thesis. At the time of applying for a degree of licentiate, the doctoral student must have published at least one article in an academic journal with peer review or have one article accepted for publication in an academic journal with peer review for a thesis consisting of a collection of articles with a short framework report. In the case of a monograph, it must have been reviewed by at least one reviewer (with no conflict of interest) who is either docent or professor. The reviewer certifies that the monograph is in line with what is expected to be presented at a licentiate seminar. The thesis should be presented orally in English or Swedish at an open seminar. The licentiate seminar is led by a chairperson who is also the examiner. An external opponent discusses the licentiate thesis with the doctoral student. The licentiate thesis must be assessed and graded either fail (*underkänd*) or pass (*godkänd*). When a grade is being set, the content of the thesis and the defence (*disputation*) must be taken into account.