Infrainformatics

/ Infrainformatik/

SCB codes: 20105, 20203, 20102

1 General description of the research area

The subject of Infra Informatics addresses issues related to the planning, design, utilization, control, and analysis of infrastructure and systems for the transportation of people, goods, and mobile telecommunications. Of particular interest is the impact of information and communication technology on these systems. The subject takes an interdisciplinary and systems-engineering approach, emphasizing the overall structure, dynamics, and complexity of the systems, and is based on both industrial and societal planning processes. In addition to purely technical aspects, the subject also considers non-technical conditions such as organizational, humanistic, and behavioural issues.
A common theme in research within the subject is that it deals in some way with flows in networks. Entities that flow can include vehicles (cars, buses, trains, airplanes, ships), people, goods and materials, information, signals, or data. The networks can be traffic networks, logistics chains, production networks, communication networks, data networks, etc. The issues may concern network design, location within networks, capacity and congestion, robustness, supply and demand, resource consumption, etc. Often, the ability to collect and process data and to communicate information to and from the networks is of great interest, and analyses often include various aspects of efficiency, behaviour, and sustainability in the systems.

Research methods in the subject include both quantitative methods such as optimization, simulation, and statistical analysis, as well as qualitative methods such as case studies, interviews, and surveys. This breadth of methods also enables an interdisciplinary approach where different theories and methods are combined.

The subject mainly belongs to the field of civil engineering and is closely related to several other subjects, particularly industrial engineering and mathematical sciences.

2 Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*.

2.1 Specific eligibility requirements

Specific eligibility requirements for admission to PhD studies in Infrainformatics are fulfilled by applicants who have completed courses amounting to at least 60 ECTS at the master's level with relevance to the research area. These 60 ECTS must include an independent project (master's thesis) of at least 30 ECTS within a field relevant to the research area.

3 Degree

PhD studies in Infrainformatics lead to either a Degree of Doctor or a Degree of Licentiate. The latter may also constitute a stage in the PhD studies. The Degree of Licentiate comprises at least 120 ECTS, of which the licentiate thesis corresponds to 60 ECTS, and courses correspond to 60 ECTS, of which at least 45 ECTS must be at PhD level. The Degree of Doctor comprises 240 ECTS, of which the doctoral thesis corresponds to 150 ECTS, and courses correspond to 90 ECTS, of which at least 75 ECTS must be at PhD level.

4 Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook*'s appendix A).

PhD studies in Infrainformatics provide the PhD student with the prerequisites to fulfill all degree outcomes. The studies consist of research and thesis work, courses, participation in seminars, participation in national and international conferences, and collaboration with industry and the surrounding society. Upon completion of the studies, the PhD student should be well prepared for work in research and development, both in industry and in academia.
The PhD studies provide the PhD student with broad knowledge and understanding of the research area of Infrainformatics by participating in the mandatory course *Introduction to Infrainformatics*, participating in research seminars within the area, and participating in undergraduate teaching related to the research area.
The PhD student acquires in-depth knowledge and understanding of Infrainformatics, and in particular of his or her research specialization, by actively participating in advanced courses, carrying out independent research work within one or several research questions or projects, participating in discussions at seminars and conferences, and, when possible, actively engaging in collaboration with companies and organizations.
The PhD student develops familiarity with scientific methodology through his or her own research and by completing a mandatory course in research methodology.
The PhD student acquires skills and abilities by:

- critically and independently planning, conducting, documenting, and communicating research work, which may include both theoretical and practical work such as modeling, data collection, testing, and analysis;
- actively participating in the scientific activities at the department and regularly presenting achieved results and plans for continued thesis work at seminars;
- co-authoring articles in scientific journals;
- participating in national and international conferences and presenting his or her research;
- contributing to undergraduate education; and
- within applied research projects, gaining familiarity with project management and insight into advanced engineering work.

Judgment and approach are developed through participation in courses in research ethics and by participating in seminars and seminar series within the research area (e.g., start-up seminars, licentiate seminars, final seminars, and lunch seminars). PhD students demonstrate intellectual independence by writing a thesis and by planning and carrying out research studies.

The PhD studies provide the PhD student with in-depth insight into the potential of science to contribute to sustainable societal development. This is achieved through mandatory learning activities (as part of faculty-wide mandatory courses), participation in ongoing discussions at, for example, research seminars, and reflection on sustainability aspects of the PhD student's own research work.

4.1 Thesis

The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*.

The PhD student demonstrates the ability to make a substantial contribution to the development of knowledge through independent research by writing a doctoral or licentiate thesis, the scientific quality of which must be approved by an examining committee (doctoral thesis) or an examiner (licentiate thesis).

A doctoral or licentiate thesis may take the form of either a monograph or a compilation thesis. A compilation thesis consists of a summary and a number of scientific articles. In both cases, the assessment is based on the overall scientific contribution, and the requirement is that the thesis contains scientific contributions that are judged to be publishable in established scientific fora.

A compilation thesis for the Degree of Doctor in Infrainformatics typically consists of 4–6 articles, of which at least 2 articles must have been accepted for publication in established scientific journals, conferences, or books. The remaining articles must be judged to meet reasonable requirements for publication. A compilation thesis for the Degree of Licentiate in Infrainformatics typically consists of 2–4 articles and a summary, of which at least one article must have been accepted for publication.

4.2 Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year.

4.3 Supervision

The general regulations for supervision can be found in the *Study Handbook for PhD Studies*, section 4, and in the faculty's policy for supervision of PhD studies.

Each PhD student shall have at least two supervisors, one of whom shall be appointed as the main supervisor. The supervisors shall participate in the planning of the education and in the selection of the research project and otherwise guide the PhD student during the period of study. The PhD student and the supervisors shall meet regularly to discuss and consult on the progress of the research work. The PhD student shall keep the supervisors regularly informed of the progress of the work.

4.4 Courses

4.4.1 Faculty course requirements

Scientific theory, methodology, ethics, gender equality and sustainability
All PhD students admitted should complete mandatory courses as decided by the faculty in Scientific theory, methodology, ethics, gender equality and sustainability, or be deemed to have equivalent competencies, in order to receive a degree.

Pedagogic studies
All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

4.4.2 Subject related courses

All PhD students must complete the course *Introduction to Infrainformatics* (10 ECTS). The course must be completed prior to the licentiate degree unless special circumstances apply. The course provides a comprehensive overview of research directions and methods within the research area.

4.4.3 Other subject-specific mandatory components

After approximately one year of studies, the PhD student shall hold a start-up seminar, at which the research task and its planned implementation are presented. A licentiate seminar (see Study Handbook) is mandatory also for PhD students who continue their studies toward a doctoral degree. The implementation and outcome of the licentiate seminar shall be documented in the individual study plan.

4.4.4 Accreditation

Accreditation of course credits is regulated by the *Study Handbook for PhD studies*, section 5.6.

5 Other information

5.1 Transitional provisions

Changes to the general study syllabus do not apply to those who have already been admitted to PhD studies in the research area. A change to the new general study syllabus may however be approved if both the main supervisor and the PhD student agree. In such a case, this should be documented in the individual study plan.

6 Commencement

1. The General study plan comes into force 01 11 2024.