ABE-04-ST-MoV **Appendix 1**

SYLLABUS FOR DOCTORAL STUDIES IN LAND AND WATER RESOURCES ENGINEERING

Within the Department of Land and Water Resources Engineering, School of Architecture and the Built Environment, KTH

This syllabus complements the KTH general regulations and guidelines for doctoral studies with specific instructions for the subject area.

SUBJECT DESCRIPTION

The subject at the doctoral level includes studies of land and water systems, and technical applications related to land use, water management and construction. The scientific basis consists of fundamental natural sciences combined with engineering, which may relate to the understanding of public engineering infrastructure, the natural environment or the interaction between the two. Natural resources are studied from a societal perspective, and links with social sciences and different cultures' attitudes to natural resources are an important part. Skills and methodologies for safeguarding and exploiting natural resources include various spatial scales, from small-scale scientific processes to entire continents and global phenomena. The research focus is on the requirements of a sustainable society, and includes an understanding of processes, technological development and social means of control. The technologies we develop are based largely on direct interaction with natural resources and are aimed at a sustainable and cost-effective use of these resources. The broad range of thesis topics and interaction between the various research groups within the department strengthen the scientific environment and promote the interdisciplinary research needed to solve major environmental problems.

GOALS OF THE PROGRAMME

The overall goals for doctoral studies in the subject of land and water resources engineering correspond to the objectives for KTH doctoral studies. They are set out in the box below:

The purpose of KTH doctoral studies is to provide society with competent researchers who can contribute to its sustainable development.

The goal of KTH doctoral studies is for doctoral students to become independent and excellent researchers. After completing their studies, doctoral students will be able to:

- describe and explain theories and empirical results in the field in question;
- formulate specific research issues in the field in question;
- use scientific method and develop new knowledge through their own scientific studies;
- critically analyze and evaluate the methods and results from own and others' scientific studies;
- present and discuss research findings in the scientific community;
- present research in an educational way outside the scientific community and in educational contexts;
- assess the ethical aspects of research within the field in question and act on these;
- identify needs for new knowledge, and understand how to initiate and direct research projects.

Education at doctoral level shall also strive to ensure that students after graduation are able to:

- participate in interdisciplinary collaboration within the field in question
- analyze the role of research in sustainable development.

The goal of the doctoral programme is to provide advanced knowledge in the subject, and for students to gain the knowledge and skills necessary to independently conduct their own research or for equivalent advanced tasks in professional careers in the field of education. The programme will provide advanced theoretical and methodological knowledge in each discipline and the ability to carry out critical appraisal of their own and others' research results.

It is also important that doctoral students gain sufficient breadth and an overview within the area to be able put their research into a larger scientific context. The ability to present research results both orally and in writing, in national and international contexts, and to discuss them with different audiences is of great importance.

GENERAL STRUCTURE OF THE PROGRAMME

A doctor's degree comprises 240 ECTS and the programme shall be structured so that it requires four years' full-time studies. A licentiate degree comprises 120 ECTS and the programme shall be structured so that it takes the equivalent of two years' full time studies. The coursework for a licentiate degree and a doctor's degree is 30 ECTS and 60 ECTS respectively. Coursework consists of advanced courses, broadening courses and research skills courses and will provide a solid foundation for a thesis as well as for professional researchers.

Each student has a main supervisor and at least one assistant supervisor. It is strongly recommended that a supervisory group is created for each student, preferably with several assistant supervisors, one of whom belongs to the same department as the main supervisor. The main supervisor has primary responsibility for the programme. The specific courses to be studied by any one student are unique for every student and depend on their research subject. Each student has an "individual study plan" which is to be established by the student and main supervisor during the admissions process. This must be reviewed and updated once every year. The review of the individual study plan should be based on a discussion between the student, the main supervisor and the other supervisors. The study plan is based on an agreement between the parties, but it may well be supplemented by a discussion about other requirements and expectations that the student and the supervisor have regarding each other (such as forms of work, publication strategies, etc.). The study plan is ratified by the doctoral programme officer.

COURSES

Courses to be studied must be in accordance with the agreement between the student and main supervisor, as drawn up in the individual study plan.

Obligatory courses

The following obligatory courses must be taken. For a **doctor's degree**, 19.5 ECTS are required, and 12 ECTS for a **licentiate degree**. For a doctoral degree all the following courses are required, while courses 3 and 4 may be omitted for a licentiate degree. Advanced studies are defined individually for each student and for each area of research.

1 Philosophy of science/theory	7.5 ECTS	Research skills
2 Research communications, publishing, presentation skills and critical review, part 1for a licentiate degree.	4.5 ECTS	Research skills / Broadening course
3 Research Communication; publishing, presentation skills and critical review, part 2 for a doctoral degree	3 ECTS	Research skills / Broadening course
4 Land and water engineering issues, case and field studies	4.5 ECTS	Advanced course

In addition to the obligatory courses above, doctoral students should take: for a licentiate degree, at least 7.5 ECTS and for a doctor's degree at least 15 ECTS advanced courses in their research area.

Examples of Advanced courses offered by the department include:

River engineering	7.5	Advanced course
Biogeophysics	7.5	Advanced course
Water treatment processes	7.5	Advanced course
Geochemistry and ecotechnology	7.5	Advanced course
GIS for environment modelling	7.5	Advanced course
Geochemical modelling with applications	7.5	Advanced course
Integrated water resources management	7.5	Advanced course
Engineering and environmental geology	7.5	Advanced course
Flow and transport in porous formations	7.5	Advanced course
Geophysical methods and applications	7.5	Advanced course
Advanced engineering geology	7.5	Advanced course
Waste management and recycling	7.5	Advanced course
Hydrological transport processes	7.5	Advanced course
Environmental risk assessment	7.5	Advanced course
Energy resources	7.5	Advanced course
Coastal engineering and management	7.5	Advanced course
Quantitative hydrology	7.5	Advanced course
Environmental impact assessment	7.5	Advanced course
Hard rock hydrogeology	7.5	Advanced course
Land and water resources engineering	7.5	Advanced course
Environmental systems analysis	7.5	Advanced course

Literature courses in the thesis area (15 ECTS)

The literature is established in the individual study plan after proposals from the supervisor in consultation with the supervisors' group and the doctoral student. An examination is required, which may be written or oral. The examination should be designed so that examiners can evaluate that the student has achieved the goals of the course. Literature courses in the thesis area may be completely or partially replaced by other relevant courses if the supervisor, in consultation with the student and other supervisors, finds this more suitable.

Optional research skills courses

The following courses provide research skills and are optional in the subject area at doctoral level. A maximum of 15 ECTS may be included in licentiate degree and a maximum of 22.5 ECTS in the doctoral degree.

Ground and water engineering questions, cases and field studies, part 2	4.5 ECTS	Broadening and Research skills
Popular science production	1.5 ECTS	Research skills
Presentation of research at international conferences, part 1 and part 2	1.5 ECTS	Research skills
Research applications	1.5 ECTS	Research skills
Supervision of thesis, part 1 and part 2	1.5 ECTS	Research skills
Writing scientific papers	4.5 ECTS	Research skills
Applied statistics	7.5 ECTS	Research skills

Doctoral students who teach in education at first or second level must have completed initial university teacher training.

Seminars and conferences

The programme includes active participation in research seminars at the department. Doctoral students should also participate in national and international conferences and research networks in the area of knowledge.

Dissertation/thesis

Dissertation/thesis work is an obligatory part of doctoral studies. This part of the programme aims are that the student develops the ability to make independent contributions to research and a capacity for scientific cooperation, within and outside their own subject. The dissertation/thesis shall contain new research results that the student has developed, alone or in cooperation with others. The main scientific results should meet the quality requirements for publication in internationally recognized journals with peer review. A doctoral student's contribution to a dissertation/thesis text that has multiple authors must be distinguishable.

Dissertations and theses must be written in English. Whether a licentiate thesis is presented as a monograph or as a collection of scientific articles, it should be of such quality that it is considered to be the basis for at least two regular articles published in internationally recognized journals with peer review. For a doctoral thesis the same applies, but for at least four regular articles. A small number of conference papers for international conferences with peer review may also be accepted.

A thesis is generally based on a licentiate dissertation.

ELIGIBILITY REQUIREMENTS AND RECOMMENDED PRIOR KNOWLEDGE

The KTH general eligibility requirements for admission to doctoral level studies apply. Doctoral students are expected to read and write scientific English and speak English fluently.

RULES FOR SELECTION OF APPLICANTS

Admission to studies at the doctoral level is decided by the school director after preparation by the programme council of the doctoral school of Land and Water Resources Engineering and the proposed main supervisor.

In addition, selection assesses the degree of maturity and capacity for independent judgement and critical analysis, as well as written scientific presentation, which forms the basis of admissions decisions and the selection of applicants. Of significance in this assessment are previous study results in advanced courses at undergraduate level and independently conducted scientific studies.

Those accepted for doctoral studies may take a licentiate degree as one stage in their studies.

EXAMINATIONS

Doctoral courses include examinations, which may be written or oral. Examinations shall be designed so that examiners can be satisfied that the student has assimilated the full course content.