Study programme for doctoral studies in the subject of Transport science
within the Department of Transport Science, School of Architecture and the Built Environment, KTH

This study programme supplements the KTH general regulations and guidelines for doctoral studies with specific instructions for the subject area.

1. DESCRIPTION OF SUBJECT

A well-functioning transport system is of paramount importance to people's daily lives and for economic development. But transport is also associated with serious safety, health and environmental problems, including climate change, and thus threatens human welfare in various respects. The goal of KTH doctoral studies in transport science is to provide society with qualified researchers who are able to build, develop and maintain an intelligent, efficient, reliable, safe and sustainable transport system in interaction with the general development of society, thus contributing to sustainable development.

The subject of transport science has two areas of specialisation: transport systems and transport infrastructure.

The area of specialisation *transport systems* includes the development and application of methods and models for analysis, planning, organisation, evaluation, control and design of an intelligent, efficient, safe and sustainable transport system for both freight and passengers, and the interaction of this system with the spatial and general development of society. Important areas of methodology are simulation of transport systems, modelling of traveller behaviour, economic and econometric modelling, computer science, operations research and applied mathematics as well as methods of social, environmental, safety and economic evaluation. The subject is interdisciplinary in nature and requires advanced studies in other disciplines, depending on the specific area of application.

The area of specialisation *transport infrastructure* includes scientific studies of roads and railroads as technical systems. It has its basis in fundamental science subjects such as physics, mechanics, chemistry and mathematics, supplemented with engineering science subjects such as structural mechanics, flow mechanics, materials science and solid mechanics. The focus in the building sector has traditionally been on new construction but is now increasingly focused on sustainable development, economics and operation and maintenance issues. This is reflected in the research profile of this area of specialisation.

2. GOALS OF THE PROGRAMME

The goals for doctoral studies in the subject of transport science correspond to the overall 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, postgraduates 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 methods and develop new knowledge through their own scientific studies
- critically analyse 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
- analyse the role of research in sustainable development.

Doctoral studies will give students a good overview of the field and sound theoretical, analytical and methodological training. This includes the ability to independently formulate and solve research tasks, and to communicate research findings to the scientific community and other clients. One main objective is to provide a good basis for continued independent activities as a researcher, investigator, planner or teacher. The training also aims to provide the capacity for interdisciplinary cooperation.

Doctoral studies should also contribute to long-term professional development in industry and society through the supply of extremely well-trained employees. This requires research at a high international level, with broad interfaces to business and society.

The primary group for recruitment of doctoral students are engineering graduates and students with master's degrees involving quantitative methods to a large degree. It is common that students have a background in transport, building science, urban planning, economics, computer science, physics and/or applied mathematics. The subject's interdisciplinary nature means that doctoral students with other backgrounds may also be suitable.

3. GENERAL STRUCTURE OF THE PROGRAMME

Doctoral studies consist of coursework and a dissertation/thesis part. Coursework may consist of lectures, literature studies, projects and problem-solving, as well as active participation in seminars and conferences. Courses may be studied within the department, at other departments at KTH or in collaboration with other Swedish or foreign research institutions.

Doctoral studies are conducted under the direction of a main supervisor, along with at least one assistant supervisor, in accordance with an established individual study programme. Doctoral students' individual study programmes will be adapted to their prior knowledge and to the area of the dissertation/thesis. Students' progress will be assessed at least once a year in connection with the review of the individual study programme carried out by the student and main supervisor. The study programme is approved by the director of doctoral studies.

A licentiate degree may be taken as part of a doctor's degree. Courses and dissertation work included in the licentiate degree may also be credited towards a doctor's degree.

For the area of specialisation *transport systems*, the following applies. The licentiate degree consists of courses of 45-60 ECTS and a dissertation part of 60-75 ECTS, totalling 120 ECTS. A doctor's degree consists of courses of 90 ECTS and a thesis part of 150 ECTS, totalling240 ECTS.

For the area of specialisation *transport infrastructure*, the following applies. The licentiate degree consists of courses of 30-40 ECTS and a dissertation part of 80-90 ECTS, totalling 120 ECTS. A doctor's degree consists of courses of 60-70 ECTS and thesis work of 170-180 ECTS, totalling 240 ECTS.

4. COURSES

Courses will be studied in accordance with the agreement between the doctoral student and the main supervisor drawn up in the individual study programme and approved by the director of doctoral studies.

4.1 For the area of specialisation transport systems, the following applies.

Compulsory courses
For a doctor's degree, the following compulsory courses are required:

Theory of science and research methodology	7.5 ECTS	Research skills course
Research methodology in transport science	7.5 ECTS	Seminar participation
Systems analysis	7.5 ECTS	Broadening course
Topics in transport science	7.5 ECTS	Advanced course

A licentiate degree requires Theory of science and research methodology (7.5 ECTS) and at least 7.5 ECTS from the other courses that are compulsory for a doctor's degree.

Other study courses in transport systems
Depending on the doctoral student's background and area of specialisation, a selection of the following or similar courses are studied, as specified in the individual study programme:

Traffic simulation models	7.5 ECTS	Advanced course
Transport forecasting models	7.5 ECTS	Advanced course
Discrete choice econometrics	7.5 ECTS	Advanced course
Rail traffic planning methods	7.5 ECTS	Advanced course
Public transport systems	7.5 ECTS	Advanced course
Transport economics	7.5 ECTS	Advanced course
Intelligent transport systems	7.5 ECTS	Advanced course
Sustainable transport systems	7.5 ECTS	Advanced course
Transport policy and analysis	7.5 ECTS	Advanced course
Driver behaviour and traffic modelling	7.5 ECTS	Advanced course
Railway signalling systems - safety and reliability	7.5 ECTS	Advanced course

Other recommended study courses
Depending on the student's background and area of specialisation, courses in the following subject areas may be appropriate. These courses are usually studied at another department or university and are specified in the individual study programme:

Computer science and programming	Research skills course
Statistics	Research skills course
Mathematical statistics	Research skills course
Reliability engineering	Research skills course
Econometrics and spatial statistics	Research skills course
Risk analysis	Broadening course
Geographic information systems	Research skills course
Network theory	Research skills course
Optimisation and systems theory	Research skills course
Microeconomics	Advanced course
Urban and regional economics	Advanced course
Planning theory	Broadening course
Scientific writing	Research skills course

Advanced literature studies in the dissertation/thesis area
Depending on the student's background and area of specialisation, an advanced literature course in the dissertation/thesis area of specialisation may be appropriate. This course and its scope are specified in the individual study programme:

Literature course in transport science	4.5-15 ECTS	Advanced Course

Other skills courses
Doctoral students who teach in first or second cycle studies must have completed initial higher education teacher training. This course and its scope are specified in the individual study programme:

Higher education teacher training	Skills course

4.2 For the area of specialisation transport infrastructure, the following applies.

Compulsory courses
For a doctor's degree the following compulsory courses are required:

Theory of science and research methodology	7.5 ECTS	Research skills course
Research methodology in transport science	7.5 ECTS	Seminar participation

In addition, for a doctor's degree at least 7.5 ECTS from the following study courses in transport infrastructure are required.

For a licentiate degree, Theory of science and research methodology (7.5 ECTS) is required and either Research methodology in transport science (7.5 ECTS) or a minimum of 7.5 ECTS from the following study courses in transport infrastructure.

Other study courses in transport infrastructure
Depending on the student's background and area of specialisation, a selection of the following or similar courses are studied, as specified in the individual study programme:

Advanced rheology	7.5 ECTS	Advanced course
Analytical design of road pavement	12 ECTS	Advanced course

Interaction between vehicle, climate and road	12 ECTS	Advanced course
Computer-aided road planning and design	7.5 ECTS	Advanced course
Operation and maintenance of transport infrastructure	7.5 ECTS	Advanced course
Unbound layer	7.5 ECTS	Advanced course
Economic and environmental analysis of transport infrastructure	7.5 ECTS	Advanced course
Asphalt technology	7.5 ECTS	Advanced course
Systems analysis	7.5 ECTS	Broadening course

Other recommended study courses
Depending on the student's background and area of specialisation, courses in the following areas may be appropriate. These courses are usually studied at another department or university and are specified in the individual study programme:

Mathematics, advanced course	Research skills course
Applied statistics	Research skills course
Applied numerical analysis	Research skills course
Solid mechanics	Research skills course
Risk analysis	Broadening course
Scientific writing	Research skills course

Advanced literature or project courses in the dissertation/thesis area
Depending on the student's background and area of specialisation, an advanced literature and/or project course in the dissertation/thesis area may be appropriate. This course and its scope are specified in the individual study programme:

Literature course in transport infrastructure	4.5 to 15 ECTS	Advanced course
Project in transport infrastructure	7.5 ECTS	Advanced course

Other skills courses
Doctoral students who teach in first or second cycle studies must have completed initial higher education teacher training. This course and its scope are specified in the individual study programme:

Higher education teacher training	Skills Course

5. SEMINARS AND CONFERENCES

The programme includes active participation in research seminars at the department as well as in the special seminars that are part of the course requirements for the compulsory seminar course. This gives doctoral students training in how to present and discuss their own and others' research. Prior to completion of licentiate or doctor's degrees, a final seminar must be held at the department with a specially appointed discussant. The student must also participate in national and international conferences and in research networks in the subject area. The student is encouraged, whenever possible, to spend time with a renowned foreign research group.

6. DISSERTATION/THESIS

Dissertation/thesis work is an obligatory part of the doctoral programme. The programme trains the doctoral student in developing the ability to make independent contributions to research and the capacity for scientific cooperation, within and outside his/her own subject.

The dissertation/thesis shall contain new research results that the student has developed, either alone or in cooperation with others. The dissertation/thesis is normally written in English. It will normally take the form of a collection of scientific works together with a specific written summary. Whether it be written as a compilation thesis or a monograph, for a licentiate degree it should be the equivalent to at least two papers, and for a doctor's degree at least four papers that could be published in international journals, international conference proceedings or international edited books of good quality with peer review. A student's contribution to a dissertation/thesis paper that has multiple authors must be distinguishable.

A doctoral thesis is usually based on a licentiate dissertation.

7. ELIGIBILITY REQUIREMENTS AND RECOMMENDED PRIOR KNOWLEDGE

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

A suitable background for applicants would be a master's degree with strong elements of quantitative methods in transport, building science, urban planning, economics, computer science, physics and/or applied mathematics. The subject's interdisciplinary nature means that doctoral students with other backgrounds may also be suitable.

8. RULES FOR SELECTION OF APPLICANTS

Recruitment of doctoral students is conducted primarily through the advertising of a doctoral student position and after employment interviews. In some cases so-called industrial doctoral students are admitted, i.e. students who are employed outside the university.

Admission to doctoral studies is decided by the Dean of the School of Architecture and the Built Environment after preparation by the programme council for the doctoral programme in transport science and the prospective main supervisor.

In addition to eligibility, the degree of maturity and capacity for independent judgement and critical analysis forms the basis of selection of applicants. Of particular interest in this assessment are previous study results in courses in the second cycle or independently conducted scientific work.

9. EXAMINATION

Doctoral studies 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.