Translation of Curriculum Statement for Graduate Level (Third-level) Education

Engineering Sciences with specialization in Electrical Discharges in the Atmosphere

Swedish title: Teknisk fysik med inriktning mot atmosfäriska urladdningar

TNTEKF01

Swedish Curriculum adopted by the Board of the Faculty of Science and Technology (Board for Third-level Education) on 2008-07-02. Revised 2020-01-15. Translation approved on 2010-09-03 and 2020-01-15.

The Curriculum Statement for Third-level Education consists of three parts: a general part, this subject specialized curriculum statement, and each doctoral student's individual study plan.

Objective
Supervision and thesis work will make the student well prepared to carry out independent scientific research. After the education, the student will be familiar with scientific questions and methods in this discipline and will have reached thorough knowledge within the specific area of the thesis. The student will be able to critically assess his/her own scientific work and that of others.

The doctoral student shall also be able to present her/his own goals and results orally and in writing to different target groups in English and, in the case of Swedish-speaking doctoral students, in Swedish.

Subject description
Atmospheric discharges encompass lightning flashes and any other electrical discharge that may result when an object is raised to a high potential either intentionally or un-intentionally. These discharges may range in length from less than 1mm to about 10 km. Lightning flashes generate strong disturbances in electrical power systems, telecommunication systems and any other electrical system. They also have environmental implications since they can generate various trace gas species in the atmosphere. High voltages are used in various
industrial as well as other man made activities such as power generation and transmission. In some cases the electrical discharges resulting from these high voltages are utilised in industrial applications and in others the electrical discharges can cause malfunctioning and break down of the system. Another type of electrical discharge which causes numerous problems in electronic industry, and sometimes leading to catastrophic explosions, is the electrostatic discharges resulting from the static charging of various objects. The post graduate education in Engineering sciences with special reference to atmospheric discharges is designed to provide a deep knowledge in the physics, characteristics and the effects of these atmospheric electrical discharges – the only educational program in Sweden that address problems and questions relevant to this field. Students have the opportunity to carry out research and education in (1) the physics of lightning flashes, (2) interaction of lightning flashes with the ionosphere, atmosphere, electrical power transmission and distribution systems, telecommunication systems and with any other man made structures, (3) the generation of trace gas species in lightning flashes, (4) lightning protection methodology, (5) physics of electrical discharges and (5) the nature and the effects of ESD. One branch of education which is being introduced is the interaction of electrical discharges with material surfaces. Students have the opportunity to carry out experiments both in the field (utilising the mobile research laboratory) and in the high voltage laboratory which has facilities to create electrical discharges with peak currents up to 200 kA with energies up to 250 kJ – a facility which is unique in the Nordic countries. Students also have access to the data that is being gathered from the lightning localisation systems that cover most part of Sweden and other Nordic countries. Facilities are also available to create electrical discharges with well defined energies using laser triggering techniques. Various collaborative links with countries in the tropics will provide the students with opportunities to carry out field experiments in lightning research in the tropics. The research work in this field is carried out in close collaboration with different industries in Sweden.

Eligibility

Basic Eligibility
The basic eligibility for third level education is described in the general part of the curriculum statement.
Special Eligibility
Special eligibility is assigned to a candidate who has taken courses within all relevant areas in the subject with sufficient breadth and depth. Thus, special eligibility is consider a candidate with one of the following:

a) has obtained a Master’s degree in engineering (Swedish “Civilingenjörsexamen”) from a Swedish Technical University/College and hence taken courses within the relevant areas of the subject
b) in a different way has gained knowledge principally to the same extent as in a), irrespectively of the country of study

Admission
Applicants for third level program in Engineering science with specialization in electrical discharges in the atmosphere must submit an application to the head of the Department of Electrical Engineering. Admissions to places in third level programs take place normally six times per year.

Upon admission to postgraduate education, the Swedish title of the degree is to be specified in the application. According to decision (TEKNAT 2012/215), postgraduate education in Engineering Sciences with specialization in Electrical Discharges in the Atmosphere shall lead to a filosofie doktorsexamen or teknologie doktorsexamen. The English rendering will in either case be a licentiate/doctorate degree of philosophy.

In connection with the admission it must be stated how it is planned to finance both the personal maintenance of the doctoral student, and her/his research.

Program structure
In connection with the admission, each doctoral student and her/his supervisor shall draw up an individual study plan after consultation with the professor in charge of the third level program. The plan is to be approved by the head of the department (by delegation of the Faculty Board), in connection with the admission.

The individual study plan shall be reviewed jointly by the doctoral student and her/his supervisor, annually, and be provided with a summary of the achieved results and the plans for the coming year. Significant changes and any disagreement on the individual study plan
shall be reported to the head of the department or, if deemed necessary, to the Board for Third-level Education.

Courses
Within the third level program there may be different kinds of courses, such as lectures, literature studies, practical training, field studies, etc. The courses are intended to provide wider insights into the subject as a complement to the specialist competence acquired in the research work. The courses included in the individual study plan may partly be selected among the following courses.

Electromagnetic compatibility
Lightning: physics and effects
Electrical discharge physics
Lightning protection
High voltage engineering
Classical electrodynamics
Numerical technique in electromagnetic theory
Spectroscopy
Grounding in power system
Material analysis
Ionizing radiation and detectors

A course in research ethics of at least 2 higher education credits is mandatory for licentiate and doctoral degree. A course in university educational theory is also mandatory for doctoral students who teach at basic and advanced level.

Requirements for doctoral degree
The requirements for doctoral degree consist of on one hand passed examinations in the courses included in the approved individual study plan of each doctoral student, and on other hand passed public defense of the doctoral thesis. The program leading to the doctoral degree amounts to 240 higher education credits (four years of full-time studies), of which the thesis part amounts to a minimum of 120 higher education credits and the course part to a minimum of 60 higher education credits.

Requirements for licentiate degree
A stage of at least 120 higher education credits (two years of full-time studies) in the third level program may be completed with a licentiate degree. The requirements for this are that the doctoral student both has
passed the examinations included in the program stage and has got an academic paper amounting to a minimum of 60 higher education credits passed. The course part amounts to a minimum of 30 higher education credits.

Other
Research on this subject “Engineering science with specialization in electrical discharges in the atmosphere” is conducted in principle in collaboration across the borders and cannot be carried out without a vital flow of information. This is necessary that the student can read and write technical scientific text in English and Swedish.

The education and the research in Engineering science with specialization in electrical discharges in the atmosphere take place mostly in close contact with Swedish industry and other research groups in Sweden and abroad. The general scientific merit that a study in this subject offers is for example appreciated in many different companies and in defense services.

Further information can be found from the department of electrical engineering, www.teknik.uu.se.