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

Engineering Science with specialisation in Electronics

Swedish title: Teknisk fysik med inriktning mot elektronik

TNTEKF03 (Department of Electrical Engineering)
TNTEKF21 (Department of Materials Science and Engineering)

Swedish Curriculum adopted by the Board of the Faculty of Science and Technology (Board for Third-cycle Education) on 2011-03-09, revision on 2019-05-15, 2020-01-15.

The Curriculum Statement for Third-cycle Education consists of three parts: a general part, this subject specialised 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 electronics, 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

Electronics describes the interaction between electric and magnetic fields as well as the motion of charged particles in various media, whereas electronic devices control the movement of charged particles. The research topic pertains to the study of these phenomena and in particular to the design of various electronic/optoelectronic components, circuits and functionalities that can be devised by utilising the same. The development of methods and processes for the
fabrication of such components plays, therefore, a pivotal role in this education. The research is of both theoretical and experimental character and contains both applied and fundamental elements. Research is carried out predominantly within the area of solid state electronics and particularly in the following specific sub-areas:

- Component design and fabrication
- Sensors and sensor technology
- Microwave engineering
- Thin film technology
- Solar cell technology
- Optoelectronics
- Flexible electronics
- Quantum electronics
- Self-powered electronic systems

All sub-areas are of applied character and subsequently the student’s research is often carried out in collaboration with industrial partners. Participation in international projects, EU in particular, is a common form of the research activity.

The research in the area of Electronics makes use of a range of advanced process equipment and processes such as ion implantation, ALD, CVD, sputtering, evaporation, dry etching and lithography, as well as a number of plasma-activated processes. Carrying out the research effectively and professionally requires knowledge in advanced characterisation techniques especially electrical, optical and optoelectronic methods. An important part in the education is to give the student substantial experience and skills working with these processes and methods as well as deep understanding about their possibilities and limitations.

Eligibility

Basic Eligibility

The basic eligibility for third cycle 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 considered to have 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 cycle programme in Engineering science with specialization in electronics must submit an application to the head of the Department of Electrical Engineering or Department of Materials Science and Engineering. Admissions to places in third cycle programmes take place normally eight 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 Science with specialisation in Electronics shall lead to a \textit{teknologie doktorsexamen}. The English rendering will 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.

Programme 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 cycle programme. 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-cycle Education.
Courses

Within the third cycle programme 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 be chosen from relevant courses given at Uppsala University, other Swedish universities and universities abroad.

Course in research ethics, for at least 2 credits, is compulsory for both licentiate and doctoral degrees. University pedagogical education, for 7.5 credits, is compulsory for doctoral students involved in teaching at the basic level (bachelor) and advanced level (master).

An introduction course for studies at the third cycle and a course for scientific writing are strongly recommended.

The range of courses offered is revised continuously. A minimum of 50 credits is required for each doctoral student to fulfil the studies. A selection of courses below is given regularly and at least two of those six 5-credits courses marked in bold and italic (no. 1 through no. 6) shall be included in the individual study plan.

1. Physics of semiconductor devices, 5-10 credits
2. Design and process for advanced semiconductor devices, 5-10 credits
3. Thin film technology, 5 credits
4. Solar cell technology, 5 credits
5. Electrical characterisation techniques for thin film technology, 5 credits
6. Optical characterisation techniques for thin films, 5 credits
7. Advanced semiconductor materials, 3-10 credits
8. Sensor technology, 5-10 credits
9. Vacuum technology, 5 credits
10. Solid-state radio frequency and microwave amplifiers, 10 credits
11. Bioelectromagnetics, 5 credits

In addition, it is expected that the doctoral student holds at least four (4) presentations at the division Friday seminar during the study time of four years. An important aspect of the presentations is to develop the ability of reaching a broader audience than the own research area of the student. For completing these presentations, the doctoral student will be awarded 1 credit.
Depending on the specialisation, it may be desirable that a non-negligible part of the courses of the individual study plan is to be selected from the field of condensed matter physics, and in particular solid state physics. In the same context, materials theory, materials science, microsystems technology, electrochemistry, physical chemistry, biophysics, biochemistry, control theory, signal processing and AI are other closely related subjcredits.

The courses should be categorised as base versus specific block. The base block comprises those 6 aforementioned courses in bold and italic style (no. 1 – no. 6), while the specific block can consist of in-depth courses closely related to the thesis work including literature.

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 defence of the doctoral thesis. The programme leading to the doctoral degree amounts to 240 credits (four years of full-time studies), of which the thesis part amounts to a minimum of 120 credits and the course part to a minimum of 50 credits.

Requirements for licentiate degree

A stage of at least 120 credits (two years of full-time studies) in the third cycle 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 credits passed. The course part amounts to a minimum of 30 credits.

Other

It is often advantageous that the thesis work in electronics be related to a specific scientific and/or technological issue of substantial relevance for industry or equally so for research institutes and similar organisations.

Further information can be obtained from the professors responsible for third cycle education in Engineering Science with specialisation in Electronics.

Website: http://www.teknik.uu.se/