Doctoral programme — Electrical Engineering

The programme description was approved by Fakultetsnämnden (Faculty Board) June 1, 2010. Valid from Autumn 10.

Programme description (KTHEST)

Programme name

Electrical Engineering (Elektro- och systemteknik)

Subject area

The doctoral programme's overall purpose and learning outcomes

The purpose of the program is to produce excellent, independent researchers who can contribute to the sustainable development of society. More specifically, the program aims to prepare the doctoral student for a highly qualified career within a specialized, yet general, discipline within the subject area of Electrical Engineering. Please refer to the first paragraph for some examples of these areas. The program has been specifically created to meet the requirements for the subject of Electrical Engineering at the third cycle level. For details, please refer to the Study Plan.

The doctoral programme’s size and recruitment

The program embraces the entire School of Electrical Engineering, which currently includes approximately 220 doctoral students and 60 faculty members with docent status.

The Director of Doctoral Studies (FA) at the School of Electrical Engineering will also fill the role of the Director of the program for Electrical Engineering (PA) that is, exercising leadership over the program. There is an executive committee (E2DOC-EC) which is comprised of the Director of the program, at least one doctoral student, and also a coordinator for each of the five tracks:

â¢ Energy and electromagnetics

â¢ Information and communications technology (ICT)

â¢ Plasma physics

â¢ Intelligent transportation systems (ITS)

These tracks represent specialized research areas included in the program.

The Director of the program and all coordinators for tracks shall be members of the KTH faculty. E2DOC-EC will participate in the entire process, from recruitment to granting of degrees. Members of E2DOC-EC will be appointed by the Director of doctoral studies at the School of Electrical Engineering.

A goal of the program is to attract students from all over the world, who have a strong background in areas related to the research subject areas.

All openings for doctoral students within the program of Electrical Engineering will be advertised externally. Exceptions to this rule may be made in certain special cases, based on the regulations pertaining to the program. Doctoral students employed in private industry are one such exception. Announcement of open positions will take place through advertising in key media, with a certain regularity, in order to attract the most qualified candidates. Regulations for selection and admission are linked to requirements for the subject of Electrical Engineering on the third cycle level. Please refer to the study plan for this subject at third cycle level.

In accordance with the development plan for the School of Electrical Engineering, an important goal is to significantly increase the number of women pursuing doctoral studies in the program.

Funding

The School of Electrical Engineering will offer partial financing of a limited number of doctoral students each year. Supervisors may nominate candidates twice a year. The Executive committee will select successful candidates.

When resources are available, financing will be offered for courses, particularly development of courses, as well as for development of administrative support services.

Courses

The courses within the doctoral programme are all offered within a third-cycle subject and are therefore presented in the study plan for the subject.

Quality enhancement activities

Besides offering a wide range of courses, quality assurance is the most important purpose of the program. The criteria for assessment of quality in studies will be based on the corresponding criteria in the Study Plan for the subject of Electrical Engineering at third cycle level. These specify that the program shall provide the doctoral student with the following:

i) Knowledge- both general and in-depth- in at least one of the research specializations within the area of Electrical Engineering

ii) Competence to do independent and excellent research. This includes being able to formulate a relevant research problem, use and development of scientific methods and critical analysis of oneâs own and othersâ research results.

iii) Competence to communicate research results to the outside world, both written and orally, within oneâs own field of expertise, as well as for teaching purposes. Progress in research is expected to be presented at conferences on a continual basis.

iv) Skills in applying ethical aspects and insights within oneâs area of expertise.

v) Competence to identify the need for new knowledge and also to initiate and lead research.

vi) Skills in analyzing oneâs own roll in development of society.

vii) Competence to participate in multi-disciplinary research projects

The key tool in quality assurance is the individual study program, which shall be established for each doctoral student. The Electrical Engineering program will implement those criteria specified in the Study plan for the subject of Electrical Engineering at the third cycle level, concerning the Individual Study Program. Every Individual Study Program will be reviewed on an annual basis, by the Director of doctoral studies and also another member of the Executive Committee.

The coordinator for each track is responsible for the quality of the courses of the respective track.

Faculty who lead a course will do a self-evaluation of the course after it is concluded. Courses with more than 10 participants must effect a student evaluation of the course.

To fulfill specification number 1 above, the study plan for the subject of Electrical Engineeringat third cycle level requires a minimum number of course credits to be earned in each of the three categories of courses, which amount is defined in the study plan.

ii) To fulfill specification number 2 above, it must be ensured that the quality of research shall be such that results may be published in internationally recognized journals with referee review. For a licentiate degree, the norm for this standard is 1 submitted journal article and 1 published conference article. Corresponding norm for a doctoral degree is 1 accepted journal article, 1 submitted journal article as well as 3 published conference papers. These norms shall however be adjusted to the extent of coursework included in a degree. Another indicator of quality is the international exchange program.

As a part of the programâs quality assurance, alumni will be contacted.

Another activity related to quality assurance within the program is the organization of yearly workshops for supervisors.

National and international network

A goal of the program is that each doctoral student be given the possiblility to visit internationally recognized research groups for an extended period. The School has an extensive network for this type of exchange.

The above is enumerated and defined in appendix 3.

Further instructions for registration

Ongoing exchange progams within the school EES

Erasmus Mundus, Signal Processing and Electric Power Systems, SETS.

CSC, Communication Theory, Signal Processing, Space and Plasma

Programme with Yung Yi, Dept of Electrical Engineering and Computer Science. KAIST, South Korea. Automatic Control

Appendixes

Appendix 1: Study plan for third-cycle subject Electrical Engineering (ELSYTEKN).

Appendix 2: List containing names and subject areas of supervisors within the programme

Appendix 3: Presentation of the programme’s national and international network

Doctoral programme — Electrical Engineering

Appendix 1: Study plan for third-cycle subject Electrical Engineering (ELSYTEKN).

The subject plan was approved by Fakultetsnämnden (Faculty Board) June 1, 2010. Valid from Autumn 10.

Subject title

Electrical Engineering (Elektro- och systemteknik)

Subject description and programme outcomes

Scientific field

The subject Electrical Engineering includes research in the area of electricity and electromagnetism. Examples of specialized areas include power electronics, electrical machines, electromagnetics, industrial control systems, microsystem technology, signal processing, automatic control, communication theory, communication networks and also fusion and space plasma physics.

The subject of Electrical Engineering is comprised of in-depth scientific studies within the framework of the Electrical Engineering doctoral program.

The doctoral program contains a range of courses organized in five tracks:

- Energy and electromagnetics
- Information and communications technology

- Microsystems
- Intelligent transportation systems
- Plasma physics

These tracks make it possible to design a course of study for each student individually. They ensure that students gain both general knowledge in the subject area and in-depth knowledge within a specific specialized field of study.

Description of possible specialisation

1. Electrical engineering (EE)
2. Sustainable energy technology and strategies (SETS)

Specification of how the programme outcomes are to be achieved

The objective of this program is to educate excellent, independent researchers who are able to contribute to the sustainable development of society. More specifically the program intends to prepare students for highly-qualified, professional research careers in one of the specialized areas of electrical engineering.

Through this course of study the doctoral student will have acquired both general and in-depth knowledge within at least one specialized area of electrical engineering. After completed studies, the doctoral student will meet the requirements of the Higher Education Ordinance SFS 2006:1053 and be able to:

- describe and explain theories and empirical results in his/her field of research.
- formulate specific research issues in this field of research.
- use scientific methods and develop new knowledge through his/her own scientific studies.
- critically analyse and evaluate methods applied and results from his/her own scientific studies and those of others.
- present and discuss research results in the scientific community.
- present research in a pedagogical manner outside the scientific community, and also in an educational context.
- assess ethical aspects of research in his/her field, and act in accordance with ethical conclusions.
- identify needs for new knowledge and be proficient in initiating and leading research.

Another goal of this program is that researchers who have completed doctoral studies will be equipped to participate in multi-disciplinary cooperative efforts on issues within their area of focus as well as being able to analyse the role of research in development of society.

The individual study programme of each doctoral student must be designed to ensure the achievement of the above-mentioned objectives. Each year when the individual study program is updated, the primary supervisor and the doctoral student together will describe the plan which will enable the student to achieve these goals. If these objectives have not been met by the time a student has completed his/her course of study, the supervisor must be prepared to provide an explanation.

Electrical engineering (EE)

Description of the specialisation

The subject electrical engineering includes research in the area of electricity and electromagnetism. Examples of specialized areas include power electronics, electrical machines, electromagnetics, industrial control systems, microsystem technology, signal processing, automatic control, communication theory, communication networks and also fusion and space plasma physics.

Current research

Current research is pursued at the School of Electrical Engineering in various areas of specialization which correspond to the different labs at the School.

Programme structure

Studies are pursued under the guidance of a primary supervisor, aided by one or more secondary supervisors, in accordance with an individual study program which has been approved by the Director of Doctoral Studies in consultation with the Executive Committee of the program.

Individual study programs must take into account the studentâs previous knowledge and skills and also the direction that thesis work is taking. Progress is to be assessed at least once a year in connection with a review of the individual study program, which is to be done jointly by the student and primary supervisor. At the same time, an assessment must also be made of the quality of the doctoral student's research environment.

Doctoral studies consist in part of a course component and in part of a thesis component. The distribution of credits between these two components is to be clearly stated in the individual study programme when it is first drawn up, as a student begins his/her studies. Based on the studentâs background and research field, a list of courses will be compiled which the student will be required to complete in order to fulfil program requirements. A number of courses at the doctoral studies level are provided through the Electrical Engineering doctoral programme. Other relevant courses found outside of the program may also be included.

The research component of the studies will be under the guidance of the primary supervisor with the support of one or more secondary supervisors.

Compulsory and recommended courses

All courses for third-cycle studies are to be classified in one of three different categories:

General skills: This category includes courses that are fundamental to research studies. These are general courses that are relevant to all doctoral students in the programme. They include university pedagogy (ways of teaching), courses in research methods, history of research and patent law.

Basic courses: This category includes courses that form the basis for studies in each specialized area.

Advanced courses: These are advanced courses at research level (third cycle) that are specific to, and provide in-depth knowledge of an area of specialization.

The Director of Doctoral Studies will determine classification of courses in consultation with the Executive Committee of the program.

Within the framework for the doctoral programme in Electrical Engineering, courses will be organized within five tracks.

Thesis

Of considerable weight in the requirements for a licentiate or a doctorate degree is the thesis. A thesis can be either a monograph or a compilation of scientific papers with an introduction and a short summary (compilation thesis). For a compilation thesis a summary must be included. The thesis must be written in English. A doctoral thesis may be based on a licentiate thesis. Both licentiate and doctoral theses must be written individually.

A licentiate thesis must contain a review of previous work in the same field and relate this new contribution to existing knowledge within the area. It must be possible to publish component parts of the licentiate thesis in recognised, international journals with referee review. The normal requirement is one submitted journal article and one published conference article.

A doctoral thesis must include new theoretical and/or empirical research results in a relevant research field and also relate this new contribution to existing knowledge in the field. It must be possible to publish component parts of the thesis in recognised, international journals with referee review. The normal requirement is to have at least one article accepted for publication, one article submitted for publication and three conference contributions published.

Sustainable energy technology and strategies (SETS)

Description of the specialisation

This specialization leads to a joint degree according to the requirements established in the Framework Agreement of the European Commission (see appendices 1-3). KTH, Comillas and TUDelft are the Higher Education Institutions awarding the joint degrees.

The Royal Institute of Technology (KTH) has, together with five other Higher Education Institutions, signed and established the Erasmus Mundus Joint Doctoral Degree in Sustainable Energy Technologies and Strategies (SETS). The other institutions are:

1. Universidad Pontificia Comillas (Comillas), Madrid, Spain
2. Delft University of Technology (TUDelft), Delft, The Netherlands
3. John's Hopkins University (JHU), Baltimore, MD, USA
4. UniversitÃ© Paris Sud 11 (Paris SUD11), Paris, France
5. Florence School of Regulation (FSR), Florence, Italy

Below follows a description of the subject matter included and the requirements for the joint degree applicable for this specialization.

Current research

SETS includes research in the following areas:

- **Future energy networks**: multi-energy carrier systems; security and reliability of energy systems; integration of renewables; integration of electric vehicles; demand side management; active networks; and de-centralized control.

- **Regulation and economics of energy systems in future European scenarios**: regulatory schemes for promoting energy transition, including new decision-tools for policy makers; regulatory incentives to promote energy efficiency; and new market designs.

- Sustainable development: definition and quantification of economic and sustainability indices for regional grids and microgrids; environmental life-cycle analysis; power system operations and design for sustainability; analysis of government policies designed to promote sustainability, including design and evaluation of international environmental agreements; monitoring and enforcement of environmental regulation.

Focus will be on analysis of sustainable energy technologies and strategies in a comprehensive manner and on contributing to economic growth and sustainable development in order to implement new strategies and technology, along with other research results.

Programme structure

The disposition of the course of study will be governed by the agreement which regulates the joint doctoral program.

Compulsory and recommended courses

There are no compulsory courses for this specialization. Recommended courses include research, theoretical courses to deepen knowledge of subjects and courses leading to generic competences, in accordance with the regulations in force at the universities awarding degrees.

Thesis

Of considerable weight in the requirements for a doctorate degree is the thesis. A thesis can be either a monograph or a compilation of scientific papers with an introduction and a short summary (compilation thesis). For a compilation thesis, a summary must be included. The thesis must be written in English, and must be written individually.

A doctoral thesis must include new theoretical and/or empirical research results in a relevant research field and also relate this new contribution to existing knowledge in the field.

At least two articles must have been published or accepted for publication in a journal listed in ***Journal Citation Report (JCR).***

Entry requirements and selection

General and special admission requirements and prior knowledge

For the specialisation Electrical engineering the following applies:

In order to be admitted to the Electrical Engineering program, the basic requirements concerning qualifications in accordance with Chapter 7, Section 39 of the Higher Education Ordinance must be met.

In addition to basic qualification requirements, a candidate must normally have earned a university degree. This degree must be the equivalent of a Master of Science in Engineering with a

concentration relevant to the research area. Normally a Master's degree (120 credits) in a relevant research field fulfils this requirement.

Applicants are expected to be able to read and write scientific texts in English as well as being able to communicate verbally in English.

For the specialisation Sustainable energy technology and strategies (SETS) the following applies:

In order to be admitted to the SETS specialization, the applicant must have completed the equivalent of 300 university credits (hÃ¶gskolepoÃ¤ng), of which at least 60 credits must be included in a Master of Science degree and on the masterâs level. This degree must be the equivalent of a Master of Science in Engineering with a concentration relevant to the research area. Applicants must exhibit sufficient skills in English, according to the criteria established annually by the Management Board of the program. To be admitted to this specialization requires a scholarship from the Erasmus Mundus SETS program.

Selection rules and procedures

For the specialisation Electrical engineering the following apply:

The selection of applicants for admission is based on their qualification, suitability and projected ability to complete doctoral studies in Electrical Engineering, especially in the field of research to which they are applying. Selection is to be made from among the candidates who fulfil the qualification requirements. Important aspects such as the applicant's degree of maturity, ability to make independent judgements and critical analyses are considered during the selection process. Applicants'study results from courses at second level or results achieved from independent project work are also important.

For the specialisation Sustainable energy technology and strategies (SETS) the following applies:

The programme’s degrees and examinations

Degree of Licentiate and Degree of Doctor (PhD)

For the specialisation Electrical engineering the following applies:

Regulations stated in the national degree ordinance and local KTH examination procedures apply.

Studies may lead to a licentiate or a doctorate degree.

The licentiate degree comprises 120 credits, of which the course component must include a minimum of 45 credits and a maximum of 60 credits. At least 50 % of the course credits must come from third cycle courses.

The following combination of courses is required for the licentiate degree:

General skills: A minimum of 5 credits and maximum of 10 credits

Basic courses: A minimum of 10 credits

Advanced courses: A minimum of 10 credits

A maximum of 10 credits from basic courses from the first and second cycle in science and technical subjects may be included in the licentiate degree. A licentiate thesis must be presented and defended in accordance with KTH regulations.

The doctorate degree comprises 240 credits of which the course component must be a minimum of 75 credits and a maximum of 120 credits. At least 60 % of the course credits must be from third cycle courses.

The following combination of courses is required for the doctorate degree:

General skills: A minimum of 10 credits and a maximum of 20 credits

Basic courses: A minimum of 20 credits

Advanced courses: A minimum of 20 credits

A maximum of 10 credits from basic courses from the first and second cycle in science and technical subjects may be included in the doctorate degree. A doctoral thesis must be presented and defended in accordance with KTH regulations. A doctoral thesis may be based on a licentiate thesis.

For the specialisation Sustainable energy technology and strategies (SETS) the following applies:

This specializations leads exclusively to the doctorate degree comprising 240 credits (hÃ¶gskolepoÃ¤ng). Regulations for examination are as given in the Higher Education Ordinance. In addition, KTHâs local regulations must be complied with by students defending their thesis at KTH. The quality review of the thesis must be done according to the procedure found in Appendix A. The public defence of the thesis must be effected according to the procedure found in Appendix A. This includes, among other things, regulations concerning the Examination Committee. The normal time span for completion of doctoral studies is four academic years, but the thesis may be defended at an earlier date if all criteria are met.

The doctoral degree includes a course component including a minimum of 60 credits (hÃ¶gskolepoÃ¤ng). At least 30 of these credits must be earned through specific, approved courses. The remaining 30 credits may be earned through research carried out by the student within the research group. These credits may be acquired from the various Higher Education Institutions included in the mobility pathway. Any course approved by one of the Higher Education Institutions in the Joint Doctorate program, will be recognized by all other partners in the program. The course component must be completed prior to the beginning of the fourth academic year.

A minimum of eighteen months must be spent at the home university. A minimum of nine months must be spent at another one of the Higher Education Institutions which awards the joint doctorate in SETS degree. If any time of the mobility is spent in the country where a studentâs Masterâs degree was awarded, then at least six months must be spent at a third Higher Education Institution.

The programme’s examinations

Courses included in the individual study program should normally entail written examinations. In certain cases, an oral examination may be permissible. The nature of the examination must be such that it is possible to measure whether the objectives of the course have been achieved.

Doctoral programme — Electrical Engineering

Appendix 2: List containing names and subject areas of supervisors within the programme

The programme description was approved by Fakultetsnämnden (Faculty Board) June 1, 2010. Valid from Autumn 10.

Alexandre Proutiere, Associate Professor/Docent, Automatic Control

Anita Kullen, Assistant Professor/Docent, Space and Plasma Physics

Arne Leijon, Professor, Communication Theory

Bastiaan Kleijn, Professor, Communication Theory

Bo Wahlberg, Professor, Automatic Control

BjÃ¶rn Ottersten, Professor, Signal Processing

Carlo Fischione, Associate Professor, Automatic Control

Chandur Sadarangani, Professor, Electrical Energy Conversion

Cristian Rojas, Assistant Professor/Docent, Automatic Control

Daniel MÃ¥nsson, Assistant Professor, Electromagnetic Engineering

Dimos Dimarogonas, Associate Professor, Automatic Control

Elling W Jacobsen, Professor, Automatic Control

Frank Niklaus, Professor, Micro and Nanosystems

Gerald Q Maguire Jr, Professor, Communication Systems

Gunnar Karlsson, Professor, Communication Networks

GyÃ¶rgy DÃ¡n, Associate Professor/Docent, Communication Networks

GÃ¶ran Engdahl, Professor, Electromagnetic Engineering

GÃ¶ran Marklund, Professor, Space and Plasma Physics

GÃ¶ran Stemme, Professor, Micro and Nanosystems

Hans Edin, Associate Professor/Docent, Electromagnetic Engineering

Hans SohlstrÃ¶m, Associate Professor/Docent, Micro and Nanosystems

Hans-Peter Nee, Professor, Electrical Energy Conversion

Henric BergsÃ¥ker, Associate professor, Fusion Plasma Physics

Henrik Sandberg, Associate professor, Automatic Control

HÃ¥kan Hjalmarsson, Professor, Automatic Control

James Gross, Associate professor, Communication Theory

Jan Scheffel, Professor, Fusion Plasma Physics

Joachim Oberhammer, Associate professor, Micro and Nanosystems

Joakim JaldÃ©n, Associate Professor/Docent, Signal Processing

Joakim LillieskÃ¶ld, Associate Professor, Industrial Information and Control Systems

Juliette Soulard, Associate Professor, Electrical Energy Conversion

Karl Henrik Johansson, Professor, Automatic Control

Kristinn BjÃ¶rgvin Gylafson, Assistant Professor, Micro and Nanosystems

Lars Jonsson, Associate Professor/Docent, Electromagnetic Engineering

Lars K Rasmussen, Professor, Communication Theory

Lars NordstrÃ¶m, Professor/docent, Industrial Information and Control Systems

Lars SÃ¶rqvist, Docent, Industrial Information and Control Systems

Lennart Harnefors, Adjunct professor, Electrical Energy Conversion

Lennart SÃ¶der, Professor, Electric Power Systems

Lina Bertling, Professor, Electromagnetic Engineering

Lorenzo Frassinetti, Associate professor, Fusion Plasma Physics

Luigi Vanfretti, Associate Professor/Docent, Electric Power Systems

Magnus Jansson, Professor, Signal Processing

Marek Rubel, Professor, Fusion Plasma Physics

Markus Flierl, Associate professor, Communication Theory

Marley Becerra, Assistant Professor, Electromagnetic Engineering

Martin Norgren, Professor, Electromagnetic Engineering

Mathias Ekstedt LÃ¶vehagen, Associate Professor, Industrial Information and Control Systems

Mats Bengtsson, Associate Professor/Docent, Signal Processing

Mats BÃ¤ckstrÃ¶m, Adjunct Professor, Electromagnetic Engineering

Mehrdad Ghandhari, Professor, Electric Power Systems

Michael Tendler, Professor, Fusion Plasma Physics

Mikael Amelin, Assistant Professor, Electric Power Systems

Mikael Johansson, Professor/docent, Automatic Control

Mikael Skoglund, Professor, Communication Theory

Ming Xiao, Associate Professor/Docent, Communication Theory

Mohammad Reza Hesamzadeh, Assistant Professor/Docent, Electric Power Systems

Niclas Roxhed, Associate Professor, Micro and Nanosystems

Nicolay Ivchenko, Associate Professor, Space and Plasma Physics

Nils Brenning, Professor, Space and Plasma Physics

Oscar Quevedo Teruel, Assistant Professor, Electromagnetic Engineering

Oskar Wallmark, Associate Professor, Electrical Energy Conversion

Panagiotis Papadimitratos, Associate Professor/docent, Communication Networks

Patrik Hilber, Assistant Professor, Electromagnetic Engineering

Per Brunsell, Professor/docent, Fusion Plasma Physics

Per Zetterberg, Researcher/docent, Signal Processing

Peter HÃ¤ndel, Professor, Signal Processing

Pontus Johnson, Professor, Industrial Information and Control Systems

Ragnar Thobaben, Associate Professor/Docent, Communication Theory

Rajeev Thottappillil, Professor, Electromagnetic Engineering

Robert LagerstrÃ¶m, Assistant Professor/Docent, Industrial Information and Control Systems

Rolf Stadler, Professor, Communication Networks

Sailing He, Professor, Electromagnetic Engineering

Sarunas Girdzijauskas, Assistant Professor, Communication Networks

Staffan Norrga, Associate Professor, Electrical Energy Conversion

Stefan Ãstlund, Professor, Electrical Energy Conversion

Svetlana Ratynskaia, Professor, Space and Plasma Physics

Thomas Jonsson, Associate Professor, Fusion Plasma Physics

Thomas Lindh, Associate Professor/Docent, Communication Networks

Tobias Oechtering, Associate Professor/Docent, Communication Theory

Tomas Karlsson, Associate Professor/Docent, Space and Plasma Physics

TorbjÃ¶rn Hellsten, Professor, Fusion Plasma Physics

Viktoria Fodor, Associate Professor/Docent, Communication Networks

Wouter used to der Wijngaart, Professor, Micro and Nanosystems

Doctoral programme — Electrical Engineering

Appendix 3: Presentation of the programme's national and international network

The programme description was approved by Fakultetsnämnden (Faculty Board) June 1, 2010. Valid from Autumn 10.

Ongoing exchange progams within the school EES

Erasmus Mundus, Signal Processing and Electric Power Systems, SETS.

CSC, Communication Theory, Signal Processing, Space and Plasma

Programme with Yung Yi, Dept of Electrical Engineering and Computer Science. KAIST, South Korea. Automatic Control