Education Guide 2015-2016

Graduate program Electrical Engineering
Dear student,

Welcome in the exciting world of Electrical Engineering!

This guide will present to you the programs of the Electrical Engineering Graduate School at Eindhoven University of Technology. It contains information on the structure, content and organization of our two-year Master's program, on the Designer's Programs (PDEng), on Doctorate opportunities and a lot of other practical information as well. The structure of the Master's program has changed significantly compared with previous years. Most of the core and elective courses have been transformed into 5 ECTS courses. In addition, a 15 ECTS internship is scheduled in the second year of the Master's program. The information in this guide is constantly subject to changes, so it is very important to regularly check our website (OASE: education.tue.nl), for the correct course schedules, examination schedules and other course details.

All courses belonging to the program are taught in the English language. There is an introduction program for foreign students in August. If you have any remaining questions, please contact the Education Office (Flux 0.125), the student counselor (Flux 0.131) or me (Flux 9.070).

I wish you a lot of success and academic pleasure in studying the leading edge of Electrical Engineering.

Prof. dr.ir. Bart Smolders | Director of Education, Electrical Engineering
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1 Master's program Electrical Engineering
1.1. What is Electrical Engineering?

Electrical Engineering is about many things that are essential parts of people’s lives. It involves power generation, communication, healthcare and the environment, and electrical engineers solve a wide range of problems related to these topics. The department’s research is strongly focused on smart, innovative electrical components and on the design of electrical systems, which may become rather complex. We cooperate closely with the regional high-tech industry and with other partners all over the world. The Electrical Engineering discipline is constantly changing. As a graduate of the Electrical Engineering Master’s program you will find yourself equipped for researching, discovering and exploring new boundaries and for leading others along that way.

1.2 Goals of the Master’s program

The purpose of our Master’s program is to enable students to work independently on complex research and design projects with the ability to rethink existing concepts and develop new ones. In the final phase of the program students will be able to present the results of their work to an international community. The curriculum of the Electrical Engineering Master’s program comprises a compulsory part, electives, one or more internships and finally a graduation project in which the student demonstrates his/her engineering ability to a high standard.

A graduate engineer will have acquired the following specific skills:

- Sufficient insight into the subject matter, methods and techniques of each of the specializations within the core subject area to be able to consult international professional literature with successful results
- The ability to communicate with specialists from other core subject areas at a professional level
- Deep insight into his/her own specialism
- Such a thorough knowledge of the subject matter, methods and techniques that he/she can apply it to solving problems and developing new knowledge where necessary
- The ability to read professional literature in international journals with a critical eye and find reference points for further development or application
- Ability to navigate his subject’s literature that he can independently keep his/her knowledge up to standard and extend it

In the area of research a graduate engineer should have acquired the following skills:

- Analysis of complex problems and recognition of analogies between complex problems
- Formulation of a hypothesis
- Formulation of a working plan for the testing of hypotheses
- Evaluation of the results of an experiment or confirmation of the results of a hypothesis
- Evaluation of the possible conclusions to be drawn from research results and how far these can be generalized

Finally, an engineer must be able to communicate in his/her subject area by:

- Writing a paper in English on a subject of study (research or design)
- Making a significant contribution to a scientific discussion on a technical subject

1.3 Outline of the Master’s program

1.3.1 Core courses and specialization path

The Master’s program starts with 3 core courses, each of which must be selected from a set of eight. Each specialization path has specific preferences of core courses. Please check section 1.3.2 for additional details.

1.3.2 Professional development

Professional Development is a set of three courses from various disciplines, relevant for your Master’s degree.

1.3.3 Elective courses

The Master of Electrical Engineering consists of at least 30 ECTS of elective courses. Valid elective courses are Master’s courses or 3rd year Bachelor’s courses offered by Electrical Engineering, by other TU/e departments or by other universities.

1.3.4 Internship

An internship is a small research project which prepares for the larger graduation project. The internships are intended to be an orientation within the area of Electrical Engineering. The internship is an ideal opportunity to gain international experience.

1.3.5 Graduation project

The final part of the Master’s program is the graduation project (45 ECTS). This includes Professional Development II (5 ECTS). The project takes about 9 months (nominally) to complete.

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Table 1: Program overview

<table>
<thead>
<tr>
<th>Course name</th>
<th>ECTS</th>
<th>Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core courses</td>
<td>15</td>
<td>Q1</td>
</tr>
<tr>
<td>Specialization path</td>
<td>10</td>
<td>Q2 and Q3</td>
</tr>
<tr>
<td>Professional development I</td>
<td>5</td>
<td>any quartile</td>
</tr>
<tr>
<td>Elective courses</td>
<td>30</td>
<td>any quartile</td>
</tr>
<tr>
<td>Internship</td>
<td>15</td>
<td>Q1, year 2</td>
</tr>
<tr>
<td>Graduation project including</td>
<td>45</td>
<td>Q2-Q4, year 2</td>
</tr>
<tr>
<td>professional development II</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Education and Examination Regulations of the Electrical Engineering Master Program are available from intranet.
A student is allowed to start his/her graduation project if no more than two electives remain to be completed (10 ECTS in total).

For more details on all these topics, see Chapter 2.

1.4 Types of Education

You will encounter different types of education in the Master of Electrical Engineering. These are described below.

1.4.1 Lectures
During lectures theoretical knowledge is presented and is accompanied by relevant practical applications. The purpose of a lecture is to pass on knowledge and gain insight. In presenting the theory the teachers often make use of slides, which will be made available on the Digital Learn and Work Environment (OASE) (see 1.7) after the lecture has taken place. The lectures are demanding for both teacher and student who will need to prepare for the lecture by reading the material beforehand. It is also important for students to make their own notes during the lecture to highlight the main issues and examples.

1.4.2 Exercise sessions
Many lectures have accompanying instructions to enable application of the theory through exercises. This is mainly an individual task. These instruction groups are smaller to allow the teacher to respond to individual questions. So make full use of this instruction and ask questions. Instructions are recognized as a successful way to get through the course material.

1.4.3 Tutorials
A tutorial is a combination of lecture and instruction whereby theory alternates with exercises.

1.4.4 Video-lectures
Many lectures have been recorded on video. You can watch these lectures at a time that suits you. See http://videocollege.tue.nl.

1.5 Internationalization

If you wish to study abroad you will have plenty of opportunities. The internship (15 ECTS) and the graduation project can be carried out at many universities and companies abroad through the research contacts of the department. If you are interested, talk to your mentor or graduation supervisor about this option.

1.5.1 How to organize this?
It is important to allow enough time to prepare well. There are many sources of information, for example the International Relations Office at the TU/e. Talk to your mentor or graduation supervisor and try to contact students who have already been abroad before you. In the department of Electrical Engineering you can always contact the international coordinator Lies Termeer, e.j.a.termeer@tue.nl, Flux 0.125, telephone 040 247 4429.

1.5.2 Language
Whatever country you go to, it is practical if you can speak the language, at least enough to get by on a daily basis. So take the time to work on this. While working as a professional musician, before I started at TU/e, I sometimes had the feeling that I needed something else besides music. At high school I always enjoyed the courses that were oriented towards the exact sciences and I had come to miss the intellectual challenge associated with them. After graduating a Bachelor's degree in music, upon discussing this issue with a friend, he lent me a book on linear algebra and I started to study the subject on my own as an experiment. During the next two months I really enjoyed gradually rediscovering and improving my mathematical skills, which gave me the confidence to give it a try: I enrolled for a Bachelor study in Electrical Engineering at Eindhoven University of Technology. During my Bachelor's study I developed a particular interest in the area of Control Systems. What fascinates me about Control Systems is the focus it puts on using the limited resources available in the most efficient way to achieve a certain goal. In my experience, it paves the way to a more sustainable society. Electrical Engineering is, at least in my experience, one of the most versatile studies with respect to areas of application. Almost everything produced by society relies on one or more of the many aspects that Electrical Engineering deals with, ranging from massive energy plants, to the smallest details in a CPU. This makes it an exciting field, but sometimes the huge amount of specialization options can become overwhelming. Luckily, the Master's programs at TU/e are tailored to help you as a student to explore your options and make a sound decision on which area to specialize in. Another great aspect of TU/e is its connection to industry, which makes it easy for students to find interesting internship opportunities outside of the university. For instance, I am currently working on an internship at Philips Research.
1.6 Examinations

1.6.1 Different kinds of examinations
Exams are usually written and oral. But in the Master’s program the teaching staff also frequently makes use of assignments, sometimes in combination with an oral explanation. Which kinds of examination apply to a specific course can be found in OASE (see section 1.7).

1.6.2 How and when
The timetable for exams can be found on OASE (see section 1.7). Most written exams take three hours. You have at least two opportunities a year for any course. You need to register for each exam (see next paragraph). In the case of an oral exam the teacher schedules a time slot in consultation with the students.

1.6.3 Registration for examinations
If you wish to take an exam, you must register via OASE (see 1.7). Mind the deadline for registration. You can withdraw up to five working days before the exam takes place. If you fail to withdraw you will be registered as a no-show. After three exam attempts your name will be removed from the list of students for the exam of this course. You need to make an appointment with the student counsellor (see paragraph). In the case of an oral exam the teacher schedules a time slot in consultation with the students.

1.6.4 Deadline for results
The teaching staff should determine the result of a written examination as soon as possible but no later than three weeks after the examination has taken place. This rule applies to all TU/e courses.

1.7 Digital Learning and Work Environment (OASE)

OASE is the digital learning and work environment of TU/e. In OASE you can:

- Request information about curricula, courses, exams and timetables
- Register for exams, courses and groups
- Create your personal timetable
- Consult course information
- Consult your results
- Consult your curriculum/set of courses
- Manage your email and calendar

OASE replaces the former StudyWeb (or DLWO), a term which you may occasionally encounter in older texts.

1.7.1 Log-in
OASE can be found via http://education.tue.nl/. Log-in with username and password that you use for TU/e email. By logging in, you will usually get access to more information.

1.7.2 Use of OASE
The left-hand corner contains some tabs (News, Activities, Sources, Persons and Search). When you are logged in you see five personal tabs in the bottom right-hand corner: Profile, Email, Agenda, Results and Timetable. These tabs contain all the information that is relevant for you.

News contains all the news about the university and the courses for which you have registered. You can change the news feeds that you wish to receive.

News channels in OASE
Often the department of Electrical Engineering is contacted by companies who have interesting internships or assignments for students to do, or who have scholarships available for our students. If you don’t want to miss out on any information about Education, Events, Internship/Vacancies related to your study Electrical Engineering or Automotive you can subscribe yourself to one or all three of these news channels on OASE. Once you are logged in and on your OASE page, you find a button NEWS STUDY PROGRAM. If you check this button you find a new button MANAGE MY NEWS CHANNELS at the bottom of the page. Please check and add the channels that you are interested in and learn about all kinds all interesting offers made by companies.

Activities provides all the course information. You can also register here for courses and exams. When you are logged in, you can also see a list of the courses for which you are registered as well as a folder with course material, announcements and timetable for these specific courses.

‘Sources’ reveals the library borrowing information and reservations. The Search tab allows you to look for information within OASE.

The personal tabs: ‘Profile’ allows you to view and alter your personal data; ‘Email’ guides you to your email; ‘Agenda’ takes you to your calendar within Outlook; ‘Results’ shows all your results to date; ‘Timetable’ shows you your timetable based on the courses for which you are registered.

1.7.3 Other information sources
You may find a couple of other information sources helpful:

- All the program information from this document: http://educationguide.tue.nl/graduate-school/, select ‘Master of Electrical Engineering’ from the ‘Master’s programs’-menu, select ‘DEES’ from the Designer’s Programs menu, or select the PhD-option from the menu. For information on the old-style program, check ‘Master’s Programs – Phasing Out’.
- For the Master’s program for HBO-graduates, see http://educationguide.tue.nl/pre-masters-programs/
- For video courses: http://videocollege.tue.nl
- An alternative (and faster) site for course information and schedules: http://owinfo.tue.nl
- For administrative information and general student services: http://w3.tue.nl/en/services/stu/
2 Details
Master's program
Electrical Engineering
2.1 Master’s programs

The Master Programs offered by the Department of Electrical Engineering are:
- Electrical Engineering (120 ECTS)
- Electrical Engineering for polytechnic (HBO) graduates (30+120 ECTS)

In two specific areas, certificate programs are available:
- Broadband Telecommunication Technology (120 ECTS)
- Care and Cure (120 ECTS)

Certificate programs (or Master Tracks) are predefined specialized versions of the general EE-master program, which are awarded with a Master diploma in Electrical Engineering and a certificate.

In the Electrical Engineering Master you specialize in electrical engineering and information technology on a state-of-the-art research level.

The Electrical Engineering for polytechnic graduates Master is based on the Electrical Engineering Master, but it is preceded by a so-called Pre-Master’s program of 30 ECTS. You may shorten the Pre-Master’s program, please contact your local HBO school for more information or contact the TU/e student counselor.

The Broadband Telecommunication Technology Master (formally a Master track) focuses on broadband telecommunication and integrates knowledge from the fields of Electrical Engineering, Mathematics and Computer Science, Applied Physics, Chemical Engineering and Technology Management.

The Care and Cure Master (formally a Master track) focuses on care and cure and integrates knowledge from the fields of Electrical Engineering, Mathematics and Applied Physics, Control Engineering and Signal Processing.

2.2 The Electrical Engineering Master’s program

Degree awarded: Master of Science in Electrical Engineering

Program length: 2 years (120 ECTS)

Entrance moments: September and February

2.2.1 Admission

The general requirements for admission to a Master’s program of the department of Electrical Engineering are:
- A relevant Bachelor degree in Electrical Engineering (or equivalent). The Bachelor’s program must be of sufficient level and quality to enable you to complete the TU/e Master’s program.
- A sufficient command of the English language since the language of instruction is English.

A Bachelor’s degree from our Electrical Engineering department automatically enables admission to all the department’s Master programs. For the admission procedures visit the website: http://www.tue.nl/en/education/tue-graduate-school/masters-programs/electrical-engineering/admission.

2.2.2 Core courses and specialization path (15+10 ECTS)

The Master’s program starts with core courses and a subsequent specialization path. The three core courses need to be selected from a set of eight. The specialization path includes courses to prepare for a specific graduation specialization within one of our research groups. Table 2a and 2b list the core courses and specialization paths that you can choose, respectively. Table 2c summarizes the core-course preferences for a specific specialization path. In all cases it is very important that you discuss your selection of core courses with your mentor. You can also consult the student counselor.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>ECTS</th>
<th>Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>5DME00</td>
<td>Complex and Functional Analysis</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5CCA0</td>
<td>Semiconductor Physics and Materials</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5DME10</td>
<td>Discrete Mathematics</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5CHA0</td>
<td>Classical and Modern Physics</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5CPA0</td>
<td>Computational Physics</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5DME20</td>
<td>Nonlinear Optimization</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5CRA0</td>
<td>Random Signals and Processes</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5CSA0</td>
<td>Modeling Dynamics</td>
<td>5</td>
<td>Q2</td>
</tr>
</tbody>
</table>
2.2.3 Professional Development (10 ECTS)
One of the components of the Electrical Engineering Master is Professional Development. This is a set of three courses from various disciplines that are relevant for your Master’s degree.

Professional Development I: Includes two courses:
- Project Management (2.5 ECTS, any quartile)
  Master’s students act as team leader for the maximum of one semester. Students may complete this topic in either the first or the second semester. It is necessary to apply via OASE. The dates will be posted on OASE.
- Cultural Integration processes (2.5 ECTS, Q1 or Q3)
  This course will increase your cultural awareness and knowledge of intercultural aspects, and will improve your intercultural communication skills by coaching a multi-cultural team of students. The course includes lectures, coaching sessions and your time with your group of international students. This group will consist of approximately four students.

Professional Development II: Research Methodology & Communication Skills (5 ECTS, any quartile)
This course is finally assessed in the graduation project and will improve your communication and research skills, both of which are essential skills for your graduation project and internship. The assessment is integrated in the graduation project.

2.2.4 Internship (15 ECTS)
Purpose of internship
An internship is a small research project which prepares for the larger graduation project. The internship is an orientation within the area of electrical engineering. The internship is also the ideal opportunity for an international and/or industrial experience.

Finding an internship
To find an appropriate internship, address one of our staff members, and discuss with him or her what you would like to do, where and when. The better you know your preferences, the more likely it is that one of our

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Table 2b: Specialization paths

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Research Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>Control Systems</td>
</tr>
<tr>
<td>ECO</td>
<td>Electro-Optical Communications</td>
</tr>
<tr>
<td>EES</td>
<td>Electrical Energy Systems</td>
</tr>
<tr>
<td>EM</td>
<td>Electromagnetics</td>
</tr>
<tr>
<td>EPE</td>
<td>Electromechanics and Power Electronics</td>
</tr>
<tr>
<td>ES</td>
<td>Electronic Systems</td>
</tr>
<tr>
<td>MSM</td>
<td>Mixed-signal Microelectronics</td>
</tr>
<tr>
<td>PHI</td>
<td>Photonic Integration</td>
</tr>
<tr>
<td>SPS</td>
<td>Signal Processing Systems</td>
</tr>
</tbody>
</table>

Table 2c: Core course preferences versus specialization path

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Discrete mathematics</th>
<th>Optimization</th>
<th>Semi-conductor</th>
<th>Random signals</th>
<th>Physics</th>
<th>Computational Physics</th>
<th>Dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>PHI</td>
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<tr>
<td>EES</td>
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<td>EPE</td>
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<tr>
<td>MSM</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SPS</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

◆ Always Relevant  ✔ Optional (could be relevant depending on your specific graduation project)
staff may be able to find the right project for you. If you try to find an internship in a specific company, ask the company for existing research contacts with the EE department. If you wish to go to a specific country, contact the international coordinator Lies Termeer, e.j.a.termeer@tue.nl, Flux 0.125, telephone 040 247 4429.

Standard internship
An internship is supervised by a staff member of the department of Electrical Engineering. It may be carried out within the department (internal), outside it (external), or as a combination. For a (partially) external internship, an external supervisor is also needed for daily supervision. The EE staff member, however, remains formally responsible for the internship. You can extend the internship with an additional 5 ECTS from your electives.

To make sure all prerequisites are fulfilled, check with the student administration of the department. For each internship you need to fill out a separate internship contract to be handed in at the student administration, Flux 0.125, before you start the internship.

2.2.5 Electives (30 ECTS)
The Master of Electrical Engineering consists of 30 ECTS worth of electives. Table 2d lists the elective courses from our department. Next to these course you may also choose courses from the list of core and specialization path courses (section 2.2.2). Other valid elective courses are 3rd year elective Bachelor courses from Electrical Engineering or courses from other TU/e departments or at other universities.

Where there is doubt, the examination committee will decide if a course is admissible as an elective. Some electives will only be taught when there are 10 or more interested students, so do not hesitate to inform the teacher of your interest in time.

You will need approval from your graduation supervisor for your electives. Your graduation supervisor will consider the relevance of the electives for the Master project and for your Master’s degree as a whole.

### Table 2d Elective courses from Electrical Engineering

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>ECTS</th>
<th>Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>5LAH0</td>
<td>Seminar: Optical Interconnection Networks</td>
<td>2.5</td>
<td>Q1</td>
</tr>
<tr>
<td>5LPc0</td>
<td>Wireless Communications</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LPbe</td>
<td>Phased Array and Smart Antennas</td>
<td>5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LPc0</td>
<td>Electromagnetics Engineering</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LEc0</td>
<td>Protection and Automation of Distribution Networks</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LEc0</td>
<td>Environment and Power Engineering</td>
<td>5</td>
<td>Q2-4</td>
</tr>
<tr>
<td>5LEc0</td>
<td>Underground Power Cables</td>
<td>5</td>
<td>Q2-4</td>
</tr>
<tr>
<td>5LEd0</td>
<td>Smart Grid Operation through ICT</td>
<td>5</td>
<td>Q2-4</td>
</tr>
<tr>
<td>5LEe0</td>
<td>Electrical Power Engineering and System Integration</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>5LFo0</td>
<td>System Integration Project</td>
<td>2.5</td>
<td>Q2-4</td>
</tr>
<tr>
<td>5LFc0</td>
<td>Pulsed Power Technology</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LH0a</td>
<td>Power Quality Phenomena</td>
<td>2.5</td>
<td>Q1-4</td>
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<tr>
<td>5LFo0</td>
<td>Terahertz Systems</td>
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<td>Q2</td>
</tr>
<tr>
<td>5Lr0b</td>
<td>Flexible and Large Area Electronics</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5Lr0b</td>
<td>Electronics: Selected Topics</td>
<td>5</td>
<td>Any</td>
</tr>
<tr>
<td>5Lr0b</td>
<td>Nonlinear Systems and Neural Networks</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5Lr0b</td>
<td>Electronics: Selected Topics</td>
<td>2.5</td>
<td>Any</td>
</tr>
<tr>
<td>5LH0a</td>
<td>Embedded Visual Control</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LJb0</td>
<td>Embedded Systems Laboratory</td>
<td>5</td>
<td>Q2-4</td>
</tr>
<tr>
<td>5Lc0a</td>
<td>Networked Embedded Systems</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LD0a</td>
<td>Systems on Silicon</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LH0a</td>
<td>Multiprocessors</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LJf0</td>
<td>Advanced Digital Circuit Design</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LJc0</td>
<td>Applied Combinatorial Algorithms</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LH0a</td>
<td>Digital Integrated Circuit Design</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5Lj0a</td>
<td>Embedded Control Systems</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5LJk0</td>
<td>Embedded Signal Processing Systems</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5Ll0a</td>
<td>Intelligent Architectures</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LMa0</td>
<td>Parallelization, Compilers and Platforms</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5Ll0a</td>
<td>Video Processing</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>5Llps</td>
<td>Digital Integrated Circuits: Fundamentals</td>
<td>2.5</td>
<td>Q2</td>
</tr>
<tr>
<td>5Ll0a</td>
<td>Model Reduction</td>
<td>5</td>
<td>Q2</td>
</tr>
</tbody>
</table>
Graduate program Electrical Engineering 2015-2016

22 | Details Master's program Electrical Engineering

2.2.6 Graduation Project (40+5 ECTS)
The final part of the Master's program is the graduation project. A graduation project is 45 ECTS, including Professional skills II. It takes 32 weeks full-time without breaks to complete. Including breaks and holidays a graduation project should not take more than nine months totally. A student is allowed to start his/her graduation project if a maximum of two electives remain to be completed (10 ECTS in total). The rules and regulations for the graduation project can be found on the digital Education Guide (http://studiegids.tue.nl/en/). They specify all the details of carrying out a graduation project.

Finding a suitable Graduation Project
Before December of your 2nd year, but preferably sooner, you must select your graduation supervisor. You take the initiative to contact him/her and together you need to agree upon the topic of the graduation project. The approval of your graduation supervisor is also required in determining the ten or more credits of regular electives.

The essentials of the graduation project are stipulated in a graduation contract between student and graduation supervisor and should be filled out and signed before actually starting your project. You can obtain a concept graduation contract by sending a request by mail to Mrs. A. Meerbach of the student administration, (a.t.meerbach@tue.nl)

Paper
The graduation project is concluded by writing a graduation paper of between 8 and 12 pages (in line with the IEEE Publications format), which describes the project and its results, and is ready to be submitted as a regular contribution to a periodical. Mrs. Meerbach takes care of the distribution of the graduation papers. The website contains an example of such a paper.

Panel
To evaluate and grade the graduation project, the examination committee appoints a graduation panel of four or five staff members. Halfway through the graduation work the student reports and presents his work thusfar to the panel. When the project has been finished, the panel meets again with the student, giving him/her the opportunity to present and defend the graduation work. The student’s graduation supervisor will be part of the panel as an advisory member, and therefore has no say in the grading. At the end of the meeting, the panel determines the student’s grade.

Graduation
In order to graduate you need to register through OASE for the final examination. The deadline is about four weeks before the examination date. Registration always refers to the first forthcoming session of the examination committee. The examination committee discusses the student, determines a final grade for the graduation project, checks whether all the Master obligations have been fulfilled and, if so, sets the date for presentation of the diploma.

To graduate cum laude (with distinction) you need to have:
• an overall (unweighted) grade average of 8.0 or higher for all the courses that are part of the program;
• a graduation project grade of 9.0 or higher;
• no program courses graded below 6.0.

2.3 The Broadband Telecommunication Technology Master track

Degree awarded: Master of Science in Electrical Engineering with Certificate Broadband Telecommunications Technology (BTT)

Program length: 2 years (120 ECTS)

Entrance moments: September and February

Telecommunication technology is a key enabler for today’s information society. The rapidly increasing demand for speed and capacity, which more than doubles every two years, together with the increasing need for mobility, makes it a field with strong dynamics and frequent introductions of new technologies in the network. Telecommunication technology is one of the broadest specializations; it integrates knowledge from the fields of:
• Electrical Engineering
• Mathematics and Computer Science
• Applied Physics

After successful completion of the 120 ECTS you receive your Master of Science in Electrical Engineering and a Certificate for completing the Broadband Telecommunication Technology program. To obtain the certificate you need to:
• Finish your graduation project in the ECO, PHI or Applied Physics research group on a BTT topic.
• You need to have approval of the set of core, specialization and elective courses from the BTT coordinator (Prof.dr.ir. A.M.J. Koonen)

### Table: Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>5LE0</td>
<td>Model Predictive Control</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5LE2</td>
<td>Robust Control</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5LMD0</td>
<td>Selected Topics in Systems and Control</td>
<td>2.5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LME0</td>
<td>Advanced Process Control</td>
<td>2.5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LSR0</td>
<td>Monitoring of Respiration and Circulation</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LSC0</td>
<td>Biomedical Sensing Technology</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>5LSD0</td>
<td>Adaptive Array Signal Processing</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5LSE0</td>
<td>Multimedia Video Coding and Architectures</td>
<td>4</td>
<td>Q3</td>
</tr>
<tr>
<td>5LTA0</td>
<td>Advanced Network Protocols</td>
<td>5</td>
<td>Q6</td>
</tr>
<tr>
<td>5LWA0</td>
<td>Design &amp; Application of Industrial Linear Motors</td>
<td>5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LWb0</td>
<td>Special Topics in Power Electronics</td>
<td>5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LWC0</td>
<td>Advanced Actuator Design</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>5LDW0</td>
<td>Low-Power Electronics</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>5LWE0</td>
<td>Control of Rotating Field Machines</td>
<td>5</td>
<td>Q4</td>
</tr>
<tr>
<td>5LWF0</td>
<td>EEM for Electromagnetic Devices</td>
<td>5</td>
<td>Q3</td>
</tr>
<tr>
<td>5LDc0</td>
<td>Data Converters 2: Design</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LTe0</td>
<td>RF Transceivers 2: Design</td>
<td>5</td>
<td>Q2</td>
</tr>
<tr>
<td>5LSC26</td>
<td>Systems &amp; Control Integration Project</td>
<td>5</td>
<td>Q4</td>
</tr>
</tbody>
</table>
2.4 The Care & Cure Master track

Degree awarded: Master of Science in Electrical Engineering with Certificate Care & Cure (C&C)
Program length: 2 years (120 ECTS)
Entrance moments: September and February

The health industry is a growing employer of electrical engineers. The Care and Cure Master track prepares for a career in this specialization. After successful completion of the 120 ECTS you receive your Master of Science in Electrical Engineering and a Certificate for completing the Care and Cure program.

To obtain the certificate you need to:
- Finish your graduation project in the SPS, EM or MSM research group on a C&C related topic.
- You need to have approval of the set of core, specialization and elective courses from the C&C coordinator (Prof.dr.ir. J.W.M. Bergmans)

2.5 The Electrical Engineering Master Program for HBO-graduates

Degree awarded: Master of Science in Electrical Engineering
Program length: 2.5 years (150 ECTS)
Entrance moments: September and February

The Electrical Engineering Master’s program for HBO graduates is based upon the general EE Master’s program. To resolve deficiencies, mainly in mathematics, a set of Bachelor’s courses is added to the program. On the other hand, fewer credits need to be taken in internships. Table 3 outlines the program. It is possible to follow one of the EE tracks (see 2.3 and 2.4) instead of the general Master’s program. More details about the Professional development, core courses, specialization path and Graduation project can be found in section 2.2.

Table 3 Electrical Engineering Master’s program for HBO graduates outline

<table>
<thead>
<tr>
<th>Year</th>
<th>Content</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>First year</td>
<td>Deficiency resolving courses</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Professional Development I</td>
<td>5</td>
</tr>
<tr>
<td>Second year</td>
<td>Master core courses</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Specialization path</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Scientific internship</td>
<td>9</td>
</tr>
<tr>
<td>Second/Third year</td>
<td>Elective courses</td>
<td>25</td>
</tr>
<tr>
<td>Third year</td>
<td>Graduation project (including Professional Development II)</td>
<td>45</td>
</tr>
</tbody>
</table>
Formally, the program is divided into a 30-ECTS Pre-Master’s program and a 120-ECTS Master’s program. Students need to complete the Pre-Master’s program before being allowed to enter the Master’s program. The Pre-Master’s program must be finished before a student is allowed to register as a Master student. The Pre-Master does not consist of a fixed number of courses, but is defined as the first 30 ECTS a student obtains from the full program (Table 3). Students are advised to complete the courses in the order outlined in Table 3, and to concentrate particularly on the math courses of Table 4 in the first year, because they are essential for the understanding of the topics later in the program.

### 2.5.1 Admission

This Master’s program is open to students with a Polytechnic (HBO) Bachelor’s degree in Electrical Engineering or equivalent. If in doubt, consult the coordinator of the program, Jan Vleeshouwers (j.m.vleeshouwers@tue.nl). Students with foreign equivalent diplomas need to apply through the formal admissions procedure for foreign students, see http://www.tue.nl/en/education/studying-attue/admission-and-enrollment/graduate-programs/admission/bachelor-from-a-university-outside-thenetherlands/ and select ‘Master admission’.

### Table 4

<table>
<thead>
<tr>
<th>Course name and code</th>
<th>Credits</th>
<th>Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English (9ST07)</td>
<td>3</td>
<td>Q1</td>
</tr>
<tr>
<td>Basic Calculus (2DL05)</td>
<td>3</td>
<td>Q1, Q3</td>
</tr>
<tr>
<td>Linear Algebra (2DL06)</td>
<td>3</td>
<td>Q1, Q3</td>
</tr>
<tr>
<td>Calculus A (2DL0a)</td>
<td>3</td>
<td>Q2, Q4</td>
</tr>
<tr>
<td>Probability &amp; Stochastics (2DL07)</td>
<td>3</td>
<td>Q2, Q4</td>
</tr>
<tr>
<td>Calculus B (2DL08)</td>
<td>3</td>
<td>Q3</td>
</tr>
<tr>
<td><strong>Electrical Engineering</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Networks HBO (5DD15)</td>
<td>3</td>
<td>Q1, Q3</td>
</tr>
<tr>
<td>Electrical Power Engineering (5EWB0*)</td>
<td>3</td>
<td>Q2</td>
</tr>
<tr>
<td>Optional: Signal Processing 1 (5EAOa*)</td>
<td>(3-5)</td>
<td>Q2</td>
</tr>
<tr>
<td>Introduction Telecommunication (5ETAo*)</td>
<td>3</td>
<td>Q3</td>
</tr>
<tr>
<td>Optional: Electronic Circuits (5ECBo*)</td>
<td>(3-5)</td>
<td>Q3</td>
</tr>
<tr>
<td>Signal Processing 2 (5ESC0*)</td>
<td>3</td>
<td>Q1</td>
</tr>
<tr>
<td>Control (5ESDo*)</td>
<td>3</td>
<td>Q1</td>
</tr>
<tr>
<td>Electromagnetics 1 (5EPA0)</td>
<td>5</td>
<td>Q1</td>
</tr>
<tr>
<td>Electronics: Basic circuitry (5ECC0*)</td>
<td>3</td>
<td>Q2</td>
</tr>
</tbody>
</table>

Courses marked with * are 5-ECTS courses of which HBO graduates only take the final test. The final test corresponds to a 3-ECTS study load.

After obtaining my Bachelor’s degree, the choice for the future was easy. I wanted to continue with pursuing a Master’s degree in Electrical Engineering. With a personal interest in signal processing, the electives were filled quickly with courses on information theory, image processing and even about measuring and analyzing electric currents in the human body. For my internship I really wanted to get work experience. Therefore, I choose for a combined internship of four months at NXP in Eindhoven. This project focused on researching the radiation patterns of a high frequency patch antenna array combined with an antenna dish. Besides support from NXP, I also discussed my progress with bright people working at the university and I learned a lot from this experience.

At the moment I am working on my graduation project, which is something completely different from my internship. I wanted a project in healthcare and selected a project in the image processing area. The aim for this project is to automatically detect stress and pain in the face of an infant using video images. I am working together with the Maxima Medical Center in Veldhoven where I get useful feedback from doctors. It is both challenging and interesting to be able to work together with a hospital.

At this point, nearly at the end of my Master in Electrical Engineering, I have no regrets at all. I followed interesting courses and was able to choose my own path.
With a regular HBO Bachelor's diploma in Electrical Engineering, the Master's program is as outlined in Table 3. In order to speed up the transition from HBO to university, some HBO schools allow to take pre-master courses at TU/e as part of the regular HBO program. For details contact our HBO program coordinator Jan Vleeshouwers.

### 2.5.2 General Bachelor’s courses (41 ECTS)

Each HBO graduate needs to pass the Bachelor’s courses listed in Table 4 (41 ECTS).

### 2.5.3 Scientific Internship (9 ECTS)

A scientific internship is a small research project which prepares for the larger graduation project. The internship is an orientation within the area of Electrical Engineering. For this reason, students are free to take this internship in the group of their choice (see 2.6). When doing an internship and a graduation project in the same group, make sure to choose topics which are sufficiently different. The internship is worth 9 ECTS (approximately six weeks’ full-time work), is supervised by a staff member of the department of Electrical Engineering and is carried out within one of the department labs. To make sure all prerequisites are fulfilled, check with the student administration of the department. Before you start the internship, you need to fill out an internship contract and hand it in at the student administration, Flux 0.125.

### 2.6 Research Groups

The Department of Electrical Engineering has organized its research into nine research groups, see the table below. For more information on these groups, visit our website: http://www.tue.nl/en/university/departments/electrical-engineering/research/

### 2.7 Timetable, class hours and calendar Academic Year

To view your personal timetable consult the OASE site (see paragraph 1.7). When you register for a course you can view your personal week or monthly timetable.

The calendar of the academic year 2015-2016 can be found on owinfo.tue.nl

### Table 5 Research Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Chairman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Energy Systems (EES)</td>
<td>dr. A.J.M. Pemen (a.i)</td>
</tr>
<tr>
<td>Electromechanics and Power Electronics (EPE)</td>
<td>prof.dr.ir. E. Lomonova</td>
</tr>
<tr>
<td>Electronic Systems (ES)</td>
<td>prof.dr.ir. A.A. Basten</td>
</tr>
<tr>
<td>Mixed-Signal Microelectronics (MsM)</td>
<td>prof.dr.ir. A.H.M. van Roermund</td>
</tr>
<tr>
<td>Control Systems (CS)</td>
<td>prof.dr.ir. P.M.J. van den Hof</td>
</tr>
<tr>
<td>Signal Processing Systems (SPS)</td>
<td>prof.dr.ir. J.W.M. Bergmans</td>
</tr>
<tr>
<td>Electro-optical Communication (ECO)</td>
<td>prof.ir. A.M.J. Koonen</td>
</tr>
<tr>
<td>Photonic Integration (PhI)</td>
<td>prof.dr. K.A. Williams</td>
</tr>
<tr>
<td>Electromagnetics (EM)</td>
<td>prof.dr. A.G. Tijhuis</td>
</tr>
</tbody>
</table>

### Table 6 TU/e class hours

<table>
<thead>
<tr>
<th>hour from until</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>from until</td>
<td>08:45</td>
<td>09:30</td>
<td>10:45</td>
<td>11:30</td>
<td>12:45</td>
</tr>
<tr>
<td>from until</td>
<td>14:45</td>
<td>15:30</td>
<td>16:45</td>
<td>17:30</td>
<td>18:45</td>
</tr>
<tr>
<td>from until</td>
<td>19:45</td>
<td>20:30</td>
<td>21:45</td>
<td>22:30</td>
<td>23:45</td>
</tr>
</tbody>
</table>

Towards the end of my Bachelor’s program Electrical Engineering at TU/e I already had quite a clear idea of the direction I wanted to specialize in for my Master’s degree. I greatly enjoy working on problems in more fundamental mathematics and physics. These can be beautifully combined with electrical engineering in the subfield of electromagnetics. The department has many contacts with industrial and academic institutes all over the globe, and these are widely made available to students. I gratefully took advantage of this and did a five-month internship in Santiago de Chile at a laboratory for astronomical instrumentation. My work there was on an array concept for bond-wire millimeter-wave antennas. Besides working on an interesting assignment, it was fantastic to make new friends, experience a totally different culture and lifestyle and do a lot of traveling and sight-seeing in my free time. This type of international endeavour can be very valuable for your scope on your future work field (and life in general) and has been a truly awesome experience. Currently, I am working on my graduation project on micromachined cavity resonator filters. My assignment is done in close collaboration with Philips, which gives me access to state of the art prototyping facilities as well as expert advice from people with years of industry experience.

I feel that the Master’s program has allowed me to gain the in-depth knowledge and skills that I need to perform the research that I find interesting. Great freedom in choosing courses and a big international network have made it easy for me to define a program that suits me as a person. Furthermore, the scientific staff members are very welcoming, which makes it easy to ask your professors for help and advice on courses and on your development as a graduate student in general.
3 Post-master designer’s program (PDEng)
in Electrical Engineering
3.1 PDEng program DEES

The Designer’s program Design of Electrical Engineering Systems (DEES) is a two-year salaried program in the field of technological design. The program leads to a Professional Doctorate in Engineering (PDEng) degree. During your program you will increase your technological knowledge, but you also learn how to apply it in practice. As well as that you work on your professional skills to increase your career opportunities. Like a doctoral candidate, you will have the status of a TU/e employee. That means you will receive a salary and have excellent secondary conditions of employment. By offering these technological Designer’s programs, TU/e is responding to the needs of the high-tech industry in the Netherlands. With a Master’s degree in Electrical Engineering you will have a sound base of theoretical knowledge, but you still lack extensive practical and application-oriented experience. During your Designer’s program you will gain this experience in particular, which means you will be in great demand by potential employers. Within the DEES program we offer two PDEng tracks:

• Information and Communication Technology (ICT)
• Healthcare System Design (HSD)

3.2 The Information and Communication Technology (ICT) program

Context

The ICT program trains designers in specifying, designing, building, testing and evaluating complex multidisciplinary systems in the domain of information and communication technology. These systems are used in the important societal research themes of the TU/e Department of Electrical Engineering. The design of innovative consumer products and professional systems that communicate with their (global) environment (e.g. wireless and electro-optical communication) is extremely challenging. This leads to many new solutions, for example embedded software, monolithic integrated (opto-) electronic circuits in the field of telecommunication, medical applications and consumer products. The ICT program educates you in the design of systems that can process, store and convey information in every sense of the word. This program includes describing and simulating circuit parts and designing and constructing system parts and components. In addition, the interaction between hard- and software is fully addressed.

Goal of the program

Application of new Information and Communication technologies is seen as one major factor to improve efficiency of complex systems while maintaining a high Quality. High-tech companies need professionals who can design and develop complex new products and processes and offer innovative solutions. Professionals who can fill the gap between market demand and technical possibilities.

The goal of the ICT program is to train engineers to innovate in the domain of ICT. The main characteristics of the program consist of:

• Design skills (requirements management, project management, model building)
• Sufficient technical knowledge in a specific area
• Specific ICT knowledge and hands-on experience
• Personal skills
• Innovation and Entrepreneurship skills

In-depth understanding of the needs and wishes of users has first priority. A designer makes choices, searches for alternatives and makes decisions, where not only logic and expertise but also creativity, intuition and good taste are very important. The decisions that are taken in the design phase have a great influence on the final product or process. They determine the major part of the production cost. The step from design to application is crucial for the innovative and competitive capabilities of a company and presents a real challenge to the creative Technological Designer. During the program the Technological Designer is being trained in detail in the latest design methods and how to apply these. Being able to synthesize, to work in multi-disciplinary teams and to use well-developed personal skills, the Technological Designer knows how to approach and to solve a problem and is therefore a very efficient employee for industry.

3.3 The Healthcare System Design (HSD) program

Context

The influence of technology in healthcare and well-being is apparent in many domains, starting from hospitals, home-healthcare, elderly assisted living and extending to healthcare related well-being applications, such as disease prevention, activity monitoring, fitness and (top-) sports programs and balanced lifestyle. Some major characteristics of the present application of technology in healthcare and wellbeing are:

• There is still a strong tendency towards technology push from medical/wellbeing (equipment) suppliers
• Healthcare professionals and health coaches primarily focus on individual clients/patients and medical/physiological knowledge. Technology is considered to facilitate their core activities
• New health-related technologies only are accepted by both health professionals and clients/patients after extensive evaluation and broad acceptance by leading experts in the field. In addition, reviews in social and other media are becoming increasingly
crucial. Prerequisite is that new technologies for healthcare and well-being have proven to be robust, non-obtrusive and reliable.

- Healthcare professionals often have severe problems with overseeing and absorbing the potential impact of new technologies.
- New technologies as such do not necessarily lead to higher efficiency of healthcare and wellbeing applications. Initially, they often even lead to an increase in cost of care.
- Healthcare and well-being related technologies rapidly move close to and even into people's homes.

A key link which appears to be missing is the translation of real 'customer' needs to new technology developments. The customers include both citizens (patients, clients and even healthy people) as well as healthcare professionals. Thus, there is a clear need for people who can translate new technology to customer benefits within the healthcare, wellbeing and sports domains.

When healthcare and well-being technology moves into homes the issue of translating available technology into relevant and really useful devices (contributing to wellbeing) becomes even harder and their integration via ICT into the healthcare eco-system more challenging. Ethics and privacy issues might be more important than technology options.

The design of professional and consumer health and wellbeing systems is an interdisciplinary process that requires in-depth understanding of both technical aspects as well as user requirements. Typically such a process is performed in an interdisciplinary team, where each team member brings in his/her own expertise and a good understanding of the field of the other team members.

It is the goal of the PDEng HSD program to educate these high level designers and thereby create the innovation potential at the interface between technology and the health and wellbeing area.

**Goal of the program**

The goal of the PDEng HSD program is to train engineers to innovate in a relevant way in this specific domain. The main characteristics of the program consist of:

- Design skills (requirements management, project management, model building)
- Sufficient technical knowledge in a specific area
- Specific healthcare and wellbeing knowledge and experience
- Personal skills
- Innovation and entrepreneurship skills

Especially the last two parts will have a number of specific components different from the other design programs: the engineers should be able to communicate directly with doctors, nurses, patients etc. and be able to translate their needs into good (technological) solutions. This is different from most design projects which operate in a business-to-business environment where specifications, even in a first stage, are already quite concrete. It is also exactly the lack of this knowledge in the field which causes many of the problems with the introduction of new technologies in healthcare and wellbeing. Key for the engineers is to learn to innovate in the real world. Therefore the program contains a major design project (and a few smaller ones) next to the curricular part of the program. The curricular part supports the engineers to innovate in a relevant way in this specific domain. The main characteristics of the program include:

- Innovate in a relevant way in this specific domain.
- A strong background of technology and application understanding he/she can work together in a team of various (also non-technical) backgrounds to solve multi-disciplinary problems.

The result of the project is the development of code that will compute and simulate the scattering electromagnetic field by multiple biological cells. Since this task is highly time consuming and memory demanding, the "macro-basis functions" method is used to obtain the solution of the system more efficiently.

The last few decades, the electromagnetic radiation that living organisms receive has increased considerably. Correspondingly, concerns have increased over the effect of this radiation. Therefore, the Electromagnetics group of TU/e is working on a project that is aimed to model the interaction between complex biological structures and electromagnetic fields. My role in this project is the development of code that will compute and simulate the electromagnetic field by multiple biological cells. Since this task is highly time consuming and memory demanding, the "macro-basis functions" method is used to obtain the solution of the system more efficiently.

Before coming here, I studied Electrical and Computer Engineering with a specialization in Telecommunications in Greece. After graduating, I was looking for a program that would ‘translate’ my theoretical knowledge into professional engineering skills. So, I was driven to the ICT PDEng program, where young engineers experience a smooth transition from the secure university surroundings to the highly demanding industrial environment. Furthermore, the international character that TU/e has, offers many opportunities to broaden your cultural horizons and get integrated into the Dutch way of working.

Challenge is the word that could describe most vividly the experience of being an ICT PDEng trainee. New design methods, multitasking, and smooth team work are some of these challenges. Through this experience, young engineers are offered a promising opportunity to become professional designers.
The important aspect of clinical trials will be introduced in a separate lecture. To further prepare trainees for future tests of their devices on patients, a course on medical ethics is part of the compulsory training. Additionally there is room to choose electives with a value of at least 7 ECTs.

**Module 3**

An important aspect of the training program is personal and professional development (Module 3). Together with a coach, the PDEng trainees develop a personal development plan for their career and follow a series of workshops, comprising self-assessment, intercultural communication, presentation training and an intensive course on technical writing and editing. Furthermore, the engineering projects are accompanied by lectures on project based management. In the monthly colloquium each trainee gives a presentation and trains his/her skills in leading discussions and participating actively as critical audience.

**Module 4**

In module 4, the trainees will get acquainted with innovation and entrepreneurship topics. This comprises, development of a business plan, marketing and sales, finance, IP and valorization as well as pitch training. A summer school is organized around an entrepreneurship topic.

**Module 5**

Module 5 are the Engineering projects. During the whole program, the trainees work on projects in parallel to their lectures. In these projects, the PDEng candidate realizes a prototype following a well-defined path from idea, specification, system level design, detailed design to realization, testing and validation. Documentation, a compact and business-oriented written report must be made of the project. The design must be publicly defended. Also some projects are within the university on the translation of new research results into a tangible prototype, typically together with a company.
3.5 Coaching

Each PDEng trainee is allocated to a specific research group of our department. A scientific staff member from this group will be your coach during the two-year period. He needs to approve your training scheme, including the electives that you have selected. When your engineering project is done in industry (or external research institute), you will get an additional coach from industry during the period of the engineering project.

3.6 Assessment of the final engineering project

The assessment of your final project will be based on the following criteria:

- Understanding own specialization (25%)
- Design skills (25%)
- Dedication (25%)
- Communication, including quality of final report and presentation (25%)

The examination panel consists of the following members:

- Chairman, Professor within the research group
- Coach, Scientific staff member from your research group
- External member, Scientific staff member from other research group
- Other members (optional)

3.7 PDEng student counselor

The Student Counselor for PDEng trainees is dr.ir. Jan Vleeshouwers. His job is to supervise, advise and provide information. He identifies bottlenecks in the system and analyses information on individual trainees with respect to study progress.

Contact: Jan Vleeshouwers, Flux 0.131, telephone 040 247 3217, email j.m.vleeshouwers@tue.nl

3.8 More information and application

If you have questions about the post-master PDEng program, please contact:

- ICT track: dr.ir. Huug de Waardt, h.d.waardt@tue.nl
- HSD track: dr.ir. Pierre Cluitmans, p.j.m.cluitmans@tue.nl
- DEES general: Rian van Gaalen, Flux 0.129, h.w.j.v.gaalen@tue.nl

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Galin Bajlekov PDEng trainee, Healthcare Systems Design

I am working on a project aiding prevention of premature labor in pregnant women, thus greatly reducing risks for babies during birth. My focus is on analyzing recorded data representing the uterine activity during pregnancy, which can be obtained non-invasively and is an indicator of preterm labor. This is the main project of my Healthcare Systems Design PDEng traineeship, which is performed within the Biomedical Diagnostics Research team, a part of the Signals Processing Systems group of the Electrical Engineering Department, in collaboration with the Maxima Medical Center in Veldhoven.

My background is mixed, with a Bachelor in Applied Physics and a Master in Neuroscience, obviously the logical next step was Electrical Engineering. I am very happy with this choice, feeling right at home in this multidisciplinary group focused on technical research in a medical setting. It provides just the right amount of challenges to keep me motivated, while offering great flexibility and allowing me to contribute in my own way. It is also inspiring to observe the great variety of other research topics that are explored here.

In addition, the 'professional' aspect of this traineeship focuses on interactions with commercial companies during the design of products and tools, which for me is a valuable skill often overlooked in a traditional academic environment.
4 Post-master Doctorate Program (PhD)
Electrical Engineering
4.1 PhD: obtaining a doctorate in engineering

After your Master’s you can choose to get more deeply involved in research. Over a period of four years you develop the capability to carry out independent research, as the start of your scientific career. As a doctoral candidate you are employed by the university and you perform an important role: you contribute to the reputation and the continuity of the research. Under the supervision of a professor, you work on a topic that fascinates you and into which you carry out further research. You need curiosity, motivation, independence, good communication skills and the ability to work in a team. If necessary, you develop these further during your work. You will write scientific papers, and give presentations at congresses and seminars to scientists in your own field. You will also carry out some teaching tasks. Finally you write and defend your PhD-thesis. If you succeed, your are entitled to use the title of doctor, or in English PhD. You can continue your research at the university, but there are also many companies which are keen to employ PhDs.

4.2 Investing in personal growth

Your PhD work is a period of scientific growth. However, Eindhoven University of Technology also finds it important to invest in your personal growth, for example by the development of your soft and communication skills. The PROOF program (PROviding Opportunities For PhD students, see http://www.tue.nl/proof) consists of various training courses that complement your scientific knowledge. The basis for your personal development is your Personal Development Plan, which you draw up together with your supervisor. Based on the agreements made in this plan, you choose the training courses that best match your own personal development.

4.3 Working at TU/e

If you are interested in becoming a PhD-student, you have to apply for a PhD position. For current vacancies, visit http://www.tue.nl/en/university/working-at-tue/development-and-career/scientific-personnel/phd-and-postdoc/, and click ’Vacancy List’. If you are accepted, you will be employed by the university. You will have a formal contract of employment for four years to carry out your doctoral research work. This means you will also be paid by TU/e.

To be admitted to a PhD position, you need to have a university diploma (Master of Science or ‘ingenieur’) or have gained an equivalent degree, for example from a university in another country.

Ballard Asare-Bediako PhD student - Electrical Energy Systems Group

I completed my bachelor education in Electrical and Electronic Engineering at the Kwame Nkrumah University of Science and Technology in Kumasi, Ghana. Thereafter, I worked as a student assistant at the same university organizing tutorial lectures for undergraduate EE students. From 2005 to 2008, I worked as a SCADA/EMS technician with Siemens AG, Power Transmission and Distribution Energy Automation 3 Group on an energy automation project in Nigeria. With the desire to know more about energy, I joined the MSc program in Sustainable Energy Technology at the University of Twente in 2008. However, I moved to Eindhoven University of Technology in 2009 for my MSc graduation thesis. Since 2010, I work as a PhD student at the Electrical Energy System Group on the topic ‘Intelligent Energy Management Systems at the Housing Level’.

Electrical energy has become a basic necessity for society and a vital entity for socio-economic development in our present world. The energy supply system is changing from the conventional centralized to decentralized generation. This transition will require a more sustainable, efficient, flexible, and intelligent infrastructure in the power systems. The residential energy consumption is increasing, therefore effective utilization and control of energy consumption and generation is crucial. My PhD project focuses on a framework for an integrated and efficient energy management system for the residential sector where decentralized and renewable energy sources are integrated with various smart loads and managed in a sustainable way. Studying in The Netherlands is enlightening. My PhD project has offered me lots of exciting experiences in modelling and simulations of electric energy systems, visiting industrial partners and residential customers, and sharing knowledge with colleagues. It is a challenging, innovative, dynamic, but most of all an enjoyable task since a smart residential electrical energy infrastructure will lead to less home energy use, reduction in carbon footprint, and increase in energy savings and grid reliability.
5 General information
5.1 The Educational Institute

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Education Office
The Education Office manages the administration and logistical aspects relating to education. In addition, the Education Office identifies bottlenecks in the education program, takes care of planning and course scheduling and provides information to students and teachers.

Contact: Annelies Meerbach (student administration), Flux 0.125, telephone 040 247 3533, email a.t.meerbach@tue.nl / Lies Termeer (international coordinator and coordinator for education information), Flux 0.125, telephone 040 247 4429, email e.j.a.termeer@tue.nl

Student Counselor
The student counselor for graduate students is dr.ir. Jan Vleeshouwers. His job is to supervise, advise and provide information. He identifies bottlenecks in the system and analyses information on individual students with respect to study progress.

Contact: Jan Vleeshouwers, Flux 0.131, telephone 040 247 3217, email j.m.vleeshouwers@tue.nl

Director of Education
This position is filled by Prof.dr.ir. Bart Smolders. He is responsible for the organizational structure and execution of the curriculum. Each year he proposes the education and examination regulations (curriculum, including content and educational structure). He discusses the content of the courses with the Professors responsible. The Director of Education is advised by the Curriculum Committee. He is also responsible for appointing the necessary lecturers within the budget specified for this purpose. He selects the lecturers from the research programs which are relevant to the subject matter of the course.

Contact: prof.dr.ir. Bart Smolders, Flux 9.070, telephone 040 247 4807, email a.b.smolders@tue.nl

5.2 The Departmental Board

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The Electrical Engineering Departmental Board consists of three members: the dean (prof.dr.ir. Ton Backx), the board member with a research portfolio (Prof.ir. Ton Koonen), and the business managing director (ir. Alfons Bruekers). The Director of Education (prof.dr.ir. Bart Smolders) is advisor to the board. There is also a student advisor, who attends meetings and, if necessary, is the voice of the students. The College Board appoints the members and student advisor. The departmental board is mandated by the College Board to organize education and research in the field of Electrical Engineering as well as draw up contracts for personnel & finance.

Contact the secretariat of the Board: Greetje van Gemert, Flux 0.159, telephone 040 247 3195, email G.v.Gemert@tue.nl

5.3 Departmental Council

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The Electrical Engineering Departmental Council is the advisory body of the department of Electrical Engineering of Eindhoven University of Technology. Its task is to follow the affairs of the department closely and submit proposals to the departmental board. Members of the departmental council are chosen from among the personnel (every two years) and students (every year) of the department. The employees and students have five seats each on the council. For questions directed towards the departmental council, please contact the chairman, Guus Pemen.

Contact: dr.ing. Guus Pemen, Flux 3.132, telephone 040 247 4492, email a.j.m.Pemen@tue.nl

5.4 Student Body (Studentenburo)

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The StudentBuro (SB) is the part of the department of Electrical Engineering that looks after the interests of students. The SB consists of three students, who serve as a contact for students on educational matters. With their daily contact with students, the StudentBuro often notices educational issues before others. If you want to know more, please visit their website.

Contact: Studentenburo, telephone 040 247 3534, email sb@sb.ele.tue.nl

5.5 Examination Committee

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The Departmental Board appoints the Examination Committee to coordinate and organize the exams within the Department of Electrical Engineering. The members of this Examination Committee are appointed by the Departmental Board. All of these members are involved in teaching within the Department.

The Examination Committee appoints examiners to examine the students. The following persons can be appointed as examiners: teaching staff from within the Department of Electrical Engineering as well as, if needed, external examiners.
as experts from outside the university. For smooth operation during the exams the Examination Committee has drafted rules and regulations about the exam in the ‘OER’ (Education and Examination Regulations). The Examination Committee will make a decision in consultation with the student and teaching staff in question.

Contact: Annelies Meerbach, Flux 0.125, telephone 040 247 3537, email a.t.meerbach@tue.nl

5.6 Curriculum Committee

The curriculum committee (in Dutch: Opleidingscommissie, OC) is appointed by the Departmental Board. Its legal tasks are:

• To advise the study program manager and the Departmental Board about the education and examination regulation (B) of both the Bachelor and Master programs
• To make an annual assessment of the execution of the education and examination regulation (M) of Bachelor and Master programs
• To advise the study program manager and Departmental Board, solicited and unsolicited, about all matters regarding the education in both the Bachelor and Master programs.

The committee focuses on the following activities:

• Monitoring and evaluation of courses
• Actions deriving from the evaluations
• Maintaining the overall view and cooperation between parties
• Preparation, initiation, execution and analysis of experiments in the education program
• Curriculum optimization and innovation
• Advice and reporting to the Faculty Board

OC meetings take place once every month. On the department website you can find information about the staff members.

Contact: drs. Martine Greijmans, Flux 0.131, telephone 040 247 2123, email m.h.m.greijmans@tue.nl

5.7 Communication and information

The Communication unit focuses on:

• Maintaining the Wall of Fame
• Organizing activities for school pupils (e.g. information- and orientation days EE)
• Organizing Public Day

Contact: Pauline van Gelder, Flux 0.155, telephone 040 247 4644, p.e.r.v.Gelder.Hoen@tue.nl

• Maintaining the website and other (online) communication tools
• Making and editing education guides and brochures
• Organizing activities for school pupils (e.g. information- and orientation days AU)
• Supporting events with regard to communication
• Highlighting the department’s research activities
• Assisting staff within the department with regard to communication

Contact: Rianne Sanders, Flux 0.155, telephone 040 247 2422, email j.j.m..sanders@tue.nl

Connecthor

Connecthor, is the magazine of the Department of Electrical Engineering, together with the study association Thor. The magazine, published four times a year, is interesting for employees, students and alumni. More information on the website. If you have questions for the editorial staff, would you like to publish an article or want to contact the editors for any other reason, please send an email.

Contact: connecthor@tue.nl

5.9 Study facilities

Library

The TU/e Library is located in the MetaForum building at the center of the campus. Its an inspiring place to study, meet fellow students and work together, offering a wealth of information resources. In the TU/e Library you will find an extensive and up-to-date collection of scientific information. A large collection of printed publications (e.g. books, journals and cartographic material is at your disposal. The Library website is the gateway to an extensive digital library. Students may borrow from the Library free of charge using a self-service loan system. Opening hours are Monday-Friday 08.00-23.00 h., and Saturday-Sunday 10.00-22.00 h. The digital library is open 24 hours a day, 7 days a week.

For more detailed go to www.tue.nl/library

Education and Student Service Center

The Education and Student Service Center (STU), provides information on student administration, internationalisation, and study guidance to students, designers, PhD students and employees. See http://w3.tue.nl/en/services/stu/

Contact: The Education and Student Service Center, tel. 040 247 4747, email stu@tue.nl

Notebook Service Center

Every first-year student (bachelor or master) with a main enrollment at the TU/e can buy a notebook from the TU/e, at a heavily subsidized price. Approximately 95% of the students take advantage of this opportunity. The notebook is supplied in a
fully assembled state, including installed software. The notebook comes with a large set of accessories: backpack, Kensington security cable and network cable. More information can be found at the central Notebook Service Center (MF 1.557, tel. 040 247 88 88) or at the NSC at the department. See http://w3.tue.nl/en/services/stu/notebook/notebook_regulation/

5.10 Student activities

Thor
The department of Electrical Engineering has its own study association, Thor (www.thor.edu). The association was formed in 1957 and is for all students of Electrical Engineering and Automotive at Eindhoven University of Technology.

Thor has two debating societies:
• ODIN, for telecommunication engineering (www.odin.ele.tue.nl)
• WALDUR, for three-phase power and energy technology (http://w3.ele.tue.nl/nl/ees/waldur/)

Thor tries to ease the study for students through all kinds of services, for instance selling Thor study books to students and organizing activities to help students prepare better for their post-graduate futures. Such activities include excursions to electrical engineering companies, study trips, symposia and meetings with former students about their careers. Finally, the association organizes various informal activities, the introduction and nice parties.

Walhalla
The Walhalla is a place where students and employees can meet outside work or study time. Apart from the cozy atmosphere, the Walhalla offers low-priced drinks. The Student Union THOR regularly organizes activities in the Walhalla and the department often uses it for social occasions and drinks after work. The Walhalla is open on work days from 16.30 - 19.00.

Contact: www.hetwalhalla.nl

IEEE Student Branch Eindhoven
IEEE is the world’s largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through its highly cited publications, conferences, technology standards, and professional and educational activities.

IEEE Student Branch Eindhoven is a local organization of IEEE by and for students of Eindhoven University of Technology. Events organized by IEEE SBE range from technology workshops, to career counseling events, to pure social events.

Contact: www.ieee.tue.nl

Sure Innovation
Sure Innovation brings together excellent masterstudents and technical companies for project work. Students will get the opportunity to get relevant working experience. Technical companies profit from well motivated students with up-to-date knowledge.

For information: http://www.tue.nl/innoveren/tue-sure-innovation/

Tech United
Tech United has different robots: the TURTLES (the soccer robots), AMIGO (the care robot) and TUlip (the humanoid robot). During the tournaments the TURTLES, AMIGO and TUlip are in the spotlights but meanwhile 80 enthusiastic team members are working hard on the robots. Students, PhD students and scientific staff make the robots work. Most of them study Mechanical Engineering, others Electrical Engineering.

Contact: www.techunited.nl/en

Solar Team Eindhoven
Solar Team Eindhoven (STE) has won the “Cruiser” class of the World Solar Challenge 2013 in Australia with its own solar-powered family car. This class is judged not only by its speed but by the number of occupants, the energy consumption and ease of use. The world’s first family car powered by the sun is a statement of a shift from just fast to user-friendly, comfortable solar-powered cars. Solar Team Eindhoven shows that driving on solar energy is no pipe dream but a viable option for practicable, everyday use.

The team consists of approximately 20 students that spend a whole year full-time working on the project. Every two year they build a car that combines practicality and comfort with extremely efficient technology.

Contact: www.solarteameindhoven.nl

TU/ecomotive
TU/ecomotive annually participates in the Shell Eco-marathon Europe, a competition in which more than 250 student teams from all over Europe compete to make the most sustainable car. The team has chosen the Urban Concept class to enter with their vehicle. Every year the team is improving the concept to make a car that has all the high tech features that we will see in the future, but because of its low weight and electric drivetrain much more fuel efficient. This year’s team created a car named Isa that is equally comfortable and practical as a normal car but driving almost 400km on the equivalent of 1 liter of gasoline.

Students can participate in the team either full-time or part-time, as a part of the study or as an extra-curricular activity.

Contact: www.tuecomotive.nl

Graduate program Electrical Engineering 2015-2016
University Racing Eindhoven

University Racing Eindhoven (URE) is a multidisciplinary student team that is taking up the challenge to design, build, test and race an electric racing car within one year and to take part in the world’s biggest international design competition: the Formula Student Competition. Throughout the competitions, the car and the team have to undergo various trials that put the design, quality and knowledge of the car and the team to the test. The events, involving more than 450 teams, are being organized at famous circuits like the Hockenheimring and Circuit de Catalunya. The aim of the competition is to offer students more practical knowledge and thus more experience alongside their studies.

The team comprises around 80 students, including many Electrical Engineering and Mechanical Engineering students, who work on the race car in their spare time.

Contact: www.universityracing.nl
More information about
Graduate program Electrical Engineering
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e-mail: voorlichting.e@tue.nl