SENSE is a MSc. programme aiming for “Smart Electrical Networks and Systems”. This programme is part of the EIT (European institute of Innovation and Technology) KIC (Knowledge & Information Community) InnoEnergy programme. It aims for [http://www.kic-innoenergy.com/education/master-school/msc-sense-smart-electrical-networks-and-systems/]:

- MSc SENSE develops student skills in electrical power engineering, innovation processes and entrepreneurship in the emerging field of Smart Grids. Its industry involvement gives students a broad industrial network plus the ability to combine engineering and entrepreneurship and develop their ability to analyse possibilities and risks from both a technical and business perspective.
- MSc SENSE focuses on understanding, modelling and analysing the principles behind electric power generation, transmission, distribution and utilisation on a broad scale. Topics range from the design, operation, control and monitoring of individual components to national power systems in their entirety.
- MSc SENSE focuses strongly on entrepreneurship and creating businesses from innovations. As well as activities integrated in ‘Smart electrical networks and systems’, other events such as study visits and seminars are also provided. The programme is based on strong interaction with its industrial and research partners, who can be found all over Europe and throughout the world.

The SENSE master programme is divided in a first year at KTH, Stockholm and a second year at one of other participating universities. This document describes the educational programme for the SENSE 2nd year at the Electrical Energy Systems (EES) group of the Electrical Engineering (EE) department at the Eindhoven University of Technology (TU/e).

**Master’s programme 2nd year SENSE at TU/e**

The educational programme consists of three parts, namely electives, internship and graduation project – totalling 60 ECTS (1 ECTS = 28 hours of workload). The electives aim to deepen the knowledge needed for internship and the graduation project. The internship is meant as a preparation for the graduation project. Course preferences are discussed with the SENSE programme coordinator at the TU/e (dr. V. Cuk), also in view of timing since electives are given throughout the one year that SENSE students reside at TU/e.

**Electives (15 ECTS)**

Basically, the same courses as for “regular” Electrical Engineering students are available as electives, with the restriction that the focus is on “Smart Electrical Networks and Systems”. The provisional list given in Table 1 is a preferential list with courses which fit within the KIC InnoEnergy – SENSE programme. Also a few courses which are a bit more distant from smart grid related topics are included, but they may be of interest for some specialisations. They are offered as a choice of maximum one out of two/three. Other courses outside the list can be taken instead, if convincingly motivated to be relevant for a student’s desired specialisation, and approved by the TU/e program coordinator.
Note, that courses should be selected that do not overlap with the content of courses from the 1st year at KTH. This may eliminate a few options from Table 1.

**Table 1: Overview of elective courses for 2nd year SENSE programme at TU/e**

<table>
<thead>
<tr>
<th>code</th>
<th>credits</th>
<th>quarter</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5LEC0</td>
<td>5</td>
<td>Q1</td>
<td>Underground &amp; submarine power cables</td>
</tr>
<tr>
<td>5LEG0</td>
<td>2.5</td>
<td>Q1</td>
<td>Power quality phenomena</td>
</tr>
<tr>
<td>5CPA0</td>
<td>2.5</td>
<td>Q1</td>
<td>Numerical methods in electrical engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-linear optimization</td>
</tr>
<tr>
<td>2DME20</td>
<td>5</td>
<td>Q1</td>
<td>Building performance and energy systems simulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control of rotating field machines</td>
</tr>
<tr>
<td>5LEB0</td>
<td>2.5</td>
<td>Q1 + Q2</td>
<td>Environment and power engineering</td>
</tr>
<tr>
<td>5SVA0</td>
<td>5</td>
<td>Q2</td>
<td>High voltage technology</td>
</tr>
<tr>
<td>5SEB0</td>
<td>5</td>
<td>Q2</td>
<td>Decentral power generation and active networks</td>
</tr>
<tr>
<td>5SWA0</td>
<td>5</td>
<td>Q2</td>
<td>Rotary permanent magnet machines</td>
</tr>
<tr>
<td>1ZM20</td>
<td>5</td>
<td>Q2</td>
<td>Technology entrepreneurship</td>
</tr>
<tr>
<td>5CKB0</td>
<td>2.5</td>
<td>Q2 or Q4</td>
<td>Project management</td>
</tr>
<tr>
<td>5SEC0</td>
<td>5</td>
<td>Q2 + Q3</td>
<td>Planning and operation of power systems</td>
</tr>
<tr>
<td>5SVB0</td>
<td>5</td>
<td>Q3</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>5LEA0</td>
<td>2.5</td>
<td>Q3</td>
<td>Protection and automation of distribution networks</td>
</tr>
<tr>
<td>5LEG0</td>
<td>5</td>
<td>Q3</td>
<td>Pulsed power technology</td>
</tr>
<tr>
<td>5SWB0</td>
<td>5</td>
<td>Q3</td>
<td>Advanced power electronics</td>
</tr>
<tr>
<td>5LED0</td>
<td>5</td>
<td>Q3</td>
<td>Smart grid operation through ICT</td>
</tr>
<tr>
<td>5XWA0</td>
<td>5</td>
<td>Q4</td>
<td>Power System Analysis and Optimization</td>
</tr>
</tbody>
</table>

The scheduling of the courses is also shown in Table 1. Most courses are 5 ECTS. A few courses are 2.5 ECTS and for 5LEG0 the theoretical part can be taken as a separate submodule of 2.5 ECTS. This allows to attend a wider range of topics, while still remaining within the 15 ECTS budget.

The students should register both to enrol the courses and to take the exams via the OSIRIS system (both actions have a deadline per quarter, indicated on the OSIRIS course information). Furthermore, this academic year 2019-2020, the administrative costs arrangement also applies for master students, i.e. after the deadline for registration, master students have to pay 20 euro per course to be registered for that course under specific conditions. See the OER articles 3.7 and 3.8 for more details. Here, you can find more information about enrolling for courses and examinations and the deadlines: https://educationguide.tue.nl/studying/planning/enrolling-courses-and-examinations/

**Internship (15 ECTS)**

The internship is meant to be a preparation on the graduation project. This preparation does not necessarily mean that the graduation is a continuation of the internship. Skills obtained from the internship, however, should be of use for the graduation project.
Internships can be proposed either by the student (e.g. found via company websites) or be chosen from the options available within the faculty. They can be external at companies or internal within the university. In all cases a TU/e supervisor is required for the internship, to be the evaluator of the research work in the end. A number of both internship and graduation projects are proposed via the Master Marketplace webpage: https://master.ele.tue.nl/

The internship should be selected by the end of the first quarter (Q1) and started at latest at the beginning of the second quarter (Q2). It is advisable to start already during Q1, leaving some space for an elective during Q2 or later.

It is possible to replace one elective by the prolongation of the internship (20 ECTS instead of 15). This is only allowed after agreement with the TU/e internship supervisor. The elective for the extension of the internship is SM030 Extension internship EE

The internship is finalized with a report, which is to be graded by the university supervisor (assistant professor, associate professor or a full professor). The evaluation of the internship is carried out in accordance with the regulation and procedure for internship evaluations at the Department of Electrical Engineering at TU/e. In particular, the criteria for the evaluation follow the regular evaluation form of the Department of Electrical Engineering.

The topic of the internship need to comply with the program of SENSE. If the topic of the internship is not defined by the EES group, or lies outside the scope of the research that is carried out in the EES group, then the internship needs to be approved by the TU/e coordinator of the SENSE program. Upon approval, the coordinator can delegate the supervision to another capacity group within the Department of Electrical Engineering (it cannot be delegated to other faculties).

When starting the internship, the student registers for the internship in the assigned capacity group following the regular procedure for internships – starting by contacting the secretary of the group. Capacity groups have the right to refuse the coaching of internships of students if the student has a curriculum or transcript that is viewed incompatible or inadequate to carry out the internship. Furthermore, the student has to fill in the internship contract which can be downloaded from the study guide (https://educationguide.tue.nl/programs/graduate-school/masters-programs/electrical-engineering/curriculum/internship/?L=2). After filling in the internship contract with the supervisor, the contract needs to be handed in at the Center for Student Administration (CSA) AP/EE in Flux 0.127

Graduation project (30 ECTS)

Like the internship, the graduation project is either proposed by the student or suggested from the available options from the Master Marketplace (https://master.ele.tue.nl/). It can be external at a company or internal at the university. In either case, supervision from the TU/e is required. Except for the duration of the graduation project, all requirements posed on “regular EE students” apply. This includes the requirement on formal procedures, on the reporting and on the panel that grades the graduation work.

The topic of the graduation project needs to comply with the program of SENSE. If the topic of the graduation project is not defined by the EES group, or lies outside the scope of the research that is carried out in the EES group, then the graduation project needs to be approved by the TU/e
coordinator of the SENSE program. Upon approval, the coordinator can delegate the supervision to another capacity group within the Department of Electrical Engineering. Capacity groups have the right to refuse the coaching of projects of SENSE students if the student has a curriculum or transcript that is viewed incompatible or inadequate to carry out the graduation project.

After agreement on topic, place and supervision, a graduation contract needs to be filled in and signed. You can ask for a concept graduation contract by sending an email to the Center for Student Administration AP/EE (CSA.EE@tue.nl). A student is allowed to start his/her graduation if a maximum of two electives remain. The internship has to be completed as well. CSA AP/EE will send you a concept graduation contract if you meet these requirements. This contract defines the starting date for the graduation project, mid-term evaluation, and expected graduation date. The starting date should be at the beginning of Q3. After the contract is completed and signed, it should be handed in at the Center for Student Administration (CSA) AP/EE in Flux 0.127.

Approximately 11 weeks after the start of the project, a graduation panel should be formed, and a mid-term presentation should be organized, to obtain feedback of the whole panel for the remainder of the project. The panel is composed by the examination rules of the Electrical Engineering faculty, and should consists of:

- the graduation professor (needs to a full professor)
- a KTH delegate as it is a dual-degree MSc program
- a voting member from the EES group (an assistant professor, associate professor or a full professor), to check the SENSE requirements
- a supervisor (can be a PhD student, PostDoc or any member of the teaching staff)
- additional advisors are optional, e.g. company supervisor(s)

The final product is a graduation paper, in line with the IEEE publications format with a length between 8 and 12 pages. More details on paper requirements can be found at:

https://educationguide.tue.nl/programs/graduate-school/masters-programs/electrical-engineering/curriculum/graduation-project/?L=2

The project and the paper is judged by a panel. The paper should be delivered to the panel at least one week prior to the presentation date.

After finalisation of the graduation work and paper, the panel meets with the student, giving him/her the opportunity to present and defend the graduation work. At the end of the meeting the grade is determined by the voting members of the graduation panel. The standard EE requirements and grading sheet are used for evaluation. The graduation defences are organized in sessions of one or two days to allow for the presence, preferably in person, of the KTH panel delegate. Note, that SENSE candidates, according to TU/e registration regulations, need to finalize all obligations related to their master study before September 1.

The presentation date should be done at least 10 working days before the examination committee meeting date. A list of examination committee meetings and graduation dates is available at:

https://educationguide.tue.nl/programs/graduate-school/masters-programs/electrical-engineering/graduation-deadlines/?L=2
Registration for a graduation date is done via the OSIRIS system, first by selecting the examination date and then also later by making a “qualification request” (via the Progress of the graduation), with deadlines indicated on OSIRIS.

The closing date for registration for the final examination is about four weeks before the date the examination committee meets. In this meeting the student is discussed, and it is checked whether all Master obligations (including those from KTH in the 1st year) have been fulfilled. It is also decided, whether a cum laude (with distinction) applies. This requires at least 9.0 for graduation project, unweighted average of at least 8.0 over all courses and assignments (including those obtained at KTH) and no grade below 6.0.
Timeline 2019-2020, TU/e

August/September 2019: Intake students by STU; meeting with SENSE coordinator EES-group on proposal electives and planning 2nd year: 15 ECTS electives; 15 ECTS internship (preparation graduation); 30 ECTS graduation. Typical planning (slight modifications can be considered when taking electives in Q3 and Q4):

- Quarter 1 (Sep-Nov): 15 ECTS or 10 ECTS electives + start internship
- Quarter 2 (Dec-Feb): internship (finalization) and (if applicable) remaining elective
- Quarter 3+4 (Mar-July): 30 ECTS graduation project

October/November 2019: Update information on individual status regarding electives and chosen internship topics

January/February 2020: Update information remaining electives / finalization internship / graduation project & contract

April/May 2020 Mid-Term presentation of the graduation work to the graduation panel/selection of the panel members (different from the SENSE MEET event)

May/June 2020: Presentation status graduation at KTH;

July/August 2020: Final defence at TU/e and decision exam committee

September/October 2020: Graduation ceremony