



**Curriculum**  
**for**  
**Aalto Doctoral Programme in Electrical**  
**Engineering 2020-2022**  
**(Aalto ELEC)**

May 2020

## Contents

In accordance with the [Aalto University General Regulations on Teaching and Studying](#), the curriculum is a confirmed overall description of the learning outcomes of the doctoral programme, the goals and the contents of its study modules and the courses offered as well as the organisation of teaching within a given period of time as indicated in the Aalto University General Regulations on Teaching and Studying (Section 2). When the curriculum is being designed, at least the following details must be specified for each course: name, scope in credits, timing, learning outcomes, implementation method, language of instruction, assessment methods, grading scale, prerequisites (if any), the unit responsible for and the teacher-in-charge of the course

<b>Contents .....</b>	<b>2</b>
<b>1. Basic information about the programme.....</b>	<b>3</b>
1.1. Name of the programme .....	3
1.2. Degree of the programme .....	3
1.3. Language of the degree .....	3
1.4. Research fields and Supervising Professors.....	3
1.5. Scope of the programme .....	4
1.6. Admission to the programme .....	4
1.7. Timetable of the degree .....	4
1.8. Doctoral programme director.....	4
<b>2. Education objectives and intended learning outcomes of the Doctoral Programme in Electrical Engineering .....</b>	<b>4</b>
<b>3. Structure of the programme .....</b>	<b>5</b>
<b>4. Content of studies.....</b>	<b>6</b>
4.1. Research field studies .....	6
4.2. Scientific practices and principles.....	7
<b>o History of Electrical Engineering and Innovations P (ELEC-A4920) .....</b>	<b>7</b>
4.3. Doctoral thesis .....	8

# 1. Basic information about the programme

## 1.1. Name of the programme

Aalto Doctoral Programme in Electrical Engineering

## 1.2. Degree of the programme

Doctor of Science (Technology)

## 1.3. Language of the degree

Finnish, Swedish, or English

## 1.4. Research fields and Supervising Professors

The Aalto Doctoral Programme in Electrical Engineering comprises 13 fields of research. The programme is a joint effort of the Departments of Electronics and Nanoengineering (ELE), Signal Processing and Acoustics (SPA), Electrical Engineering and Automation (EEA), and Communications and Networking (TLV), as well as the Metsähovi Radio Observatory and Micronova – the Research Centre for Micro- and Nanotechnology.

The doctoral candidate chooses a research field when applying to the programme. The professor supervising the doctoral studies is agreed upon at the same time. The supervising professor is a professor at the tenure track. For special reasons and with the approval of the department head and on the decision of the Dean, a non-tenure track professor can be assigned as the supervising professor of a doctoral candidate.

The research fields for the academic years 2020–2022 are:

- Electrical Power and Energy Engineering/Sähkö- ja energiatekniikka/ Elkraft- och energiteknik
- Automation and Control Engineering/Automaatio ja säätötekniikka/ Automation och reglerteknik
- Robotics and Autonomous Systems/Robotiikka ja autonomiset järjestelmät/ Robotik och autonoma system
- Electronic and Digital Systems/Elektroniset ja digitaaliset järjestelmät/ Elektroniska och digitala system
- Biosensing and Bioelectronics/Biomittaminen ja bioelektronikka/ Biomäteteknik och bioelektronik
- Electronics/Elektronikka/Elektronik
- Photonics and Nanotechnology/Fotoniikka ja nanotekniikka/Fotonik och nanoteknik
- Radio Science and Engineering/Radiotiede ja -tekniikka/Radiovetenskap och radioteknik
- Space Science and Technology/Avaruustiede ja -tekniikka/Rymdfysik och rymdteknik
- Signal Processing and Data Analytics/Signaalinkäsittely ja data-analyysi/ Signalbehandling och dataanalys
- Acoustics and Speech Technology/Akustiikka ja puheteknologia/ Akustik och talteknologi
- Communications Engineering and Networking Technology/ Tietoliikenne- ja tietoverkkotekniikka/Kommunikations- och nätverksteknik
- Interactive Systems/Vuorovaikutteiset järjestelmät/Interaktiva system

The research field descriptions and the professors in charge of the research fields can be found [here](#).

### **1.5. Scope of the programme**

The programme should be able to be completed in four years, if studied full time. The programme consists of theoretical studies including transferable skills and studies in the research field, in addition to the thesis itself.

### **1.6. Admission to the programme**

The admission of new doctoral candidates is defined in the admission criteria of Aalto<sup>1</sup> and the admission criteria of the programme<sup>2</sup>.

### **1.7. Timetable of the degree**

4 years of full-time study

8 years of part-time study

### **1.8. Doctoral programme director**

Professor Ari Sihvola

The doctoral programme director is in charge of the planning, execution, assessment and development of the programme.

## **2. Education objectives and intended learning outcomes of the Doctoral Programme in Electrical Engineering**

Aalto University's strategic objectives is to educate professionals with the knowledge and capabilities to build a sustainable society and to increase well-being through disruptive change<sup>3</sup>. These capabilities need to be rooted in disciplinary excellence augmented by art, creativity, multidisciplinary collaboration and entrepreneurship.

Each doctoral candidate makes a study plan, research plan, supervision plan, financial plan, and an optional career plan. Their implementation is followed up by the supervising professor. The supervising professor is also responsible for the supervision arrangements of the doctoral candidate.

The doctoral programme in electrical engineering prepares the doctoral candidate for an academic career as a highly qualified researcher, or outside academia in other promising areas, for example entrepreneurship.

The doctoral education is carried out in a multidisciplinary international scientific community through research work and various forms of learning. Our high-quality education is based on the research fields we offer and includes transferable-skills training and many possibilities for networking. These ensure the development of the doctoral candidate's scientific qualifications along with his/her individually oriented proficiencies for working life.

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<sup>1</sup> Aalto University Admission Criteria

<sup>2</sup> Admission criteria to the Doctoral Programme in Electrical Engineering

<sup>3</sup> [Aalto University Policies on Curriculum Design for 2020-2021 and 2021-2022, section 1.2.](#)

Electrical Engineering is a broad multidisciplinary study programme providing graduates with the ability to work in a variety of fields ranging from traditional electrical engineering and the energy sector to biomedical engineering, robotics, nanotechnology and communications engineering. Based on a strong mathematical and natural science foundation, the curriculum is flexible, allowing doctoral candidates to compile their own combination of courses and research according to their own interests. The programme covers all disciplines of the School of Electrical Engineering and allows multi-disciplinary co-operation across Aalto University.

Graduates will have the ability to work in a multidisciplinary and international environment together with various actors. They have the skills required for serving in demanding academic research and teaching positions and to act in expert, development and management positions of the information society. They will also have the competence to search for and apply knowledge, and the ability to use scientific research methods and to create new scientific knowledge.

They will be able to publish scientific results in peer-reviewed publications and disseminate the results on scientific forums. They will be able to make such syntheses and critical assessments as are required to solve complex problems in research and innovation and in other areas of society. They will have versatile written and oral communication skills and be able to work and communicate in international communities. They will work responsibly in the light of ethical and sustainable considerations and their work in the scientific community will follow good scientific practice.

### 3. Structure of the programme

Doctoral studies at Aalto University consist of an approved doctoral thesis and study modules<sup>4</sup>. In the Doctoral Programme of Electrical Engineering, the study modules comprise research field studies as well as scientific practices and principles in total of 40 ECTS. The completion of a doctoral degree equals four years of full-time studies.

<b>Doctoral thesis</b>	Research field studies (20-35 ECTS)
	Scientific practices and principles (5-20 ECTS)

<sup>4</sup> [Aalto University General Regulations on Teaching and Studying \(OOS\) Appendix: Section 43a DEGREE REGULATIONS ON DOCTORAL EDUCATION](#)

## 4. Content of studies

Every doctoral candidate plans together with his/her supervising professor, which studies should be included in the personal study plan. Thereafter, the personal study plans are confirmed.

Doctoral studies are completed in the form of study modules<sup>5</sup>. Those admitted to doctoral education shall:

- i) pursue studies that deal with the preparation for research work, the application of research results and the dissemination of research findings;
- ii) gain comprehensive and in-depth knowledge of a research field;
- iii) learn the principles of responsible conduct of research.

Courses can be found here: <https://into.aalto.fi/display/endoctoralelec/Courses+offered>

### 4.1. Research field studies

The aim of the research field studies is to prepare the doctoral candidates for research work and other demanding work that requires expertise.

After completing the module, the doctoral candidate:

- has knowledge of the background to their research field at an advanced level
- knows the key publication series of their fields
- has specific research methodology knowledge appropriate to their PhD focus
- has experience of the practical implementation of appropriate research methodologies in a learning environment

#### Scope of the module

The scope of the module is 20–35 ECTS

#### Content of the module

The content of the module is confirmed individually for each doctoral candidate following the requirements of the Doctoral Programme in Electrical Engineering:

<https://into.aalto.fi/display/endoctoralelec/Study+plan>

#### The module may include the following:

- Doctoral-level courses in the research field, which support the doctoral thesis research work
- Individual study attainments, to be agreed with the supervising professor:

Individual study attainment	ECTS	Max. amount of ECTS
Summer/winter schools	2–3 ECTS/week	-
Self-study (e.g. books, journal or conference articles; written/oral exam/review or a report to demonstrate learning)	1–10 ECTS	-

<sup>5</sup> Degree Regulations on Doctoral Education as of 1 August 2018.

## Restrictions

- Only two master level courses (advanced level) can be included in the degree, without any further reasoning. A third master level course might be included for specific reasons given by the supervising professor.
- No bachelor level courses can be included in the degree

## Evaluation of the module

- No grade is given for the module. Individual courses and study attainments are graded with grades 1-5 or as pass/fail.

## 4.2. Scientific practices and principles

The aim of the module is to provide doctoral candidates with knowledge of the basic concepts of science, the key characteristics of scientific research and scientific knowledge, familiarization with the most important research methods of their research field, and to develop their transferable skills.

After completing the module, doctoral candidates:

- are able to apply the principles of good scientific practices in their own research
- are able to apply the basic structure of scientific publications to their research reports
- have gained the ability to draft an appropriate and suitable structure for their doctoral thesis
- know the principles of scientific writing and communication
- have transferrable skills according to their career plans

## Scope of the module

The scope of the module is 5-20 ECTS

## Content of the module

The content of the module is confirmed individually for each doctoral candidate following the requirements of the Doctoral Programme in Electrical Engineering:

<https://into.aalto.fi/display/endoctoralelec/Study+plan>

The module may include the following:

- Advanced and postgraduate-level courses:
  - Introduction to doctoral studies (ELEC-L0902), highly recommended
  - Research methodology
  - History of Electrical Engineering and Innovations P (ELEC-A4920)
  - Patents (MEC-E9020)
  - Law in Digital Society (CS-E5370)
- Transferable skills and competences:
  - Aalto University Communication courses:
    - <https://into.aalto.fi/display/enopinnot/Courses+for+doctoral+students>
  - Nationally jointly developed courses (offered via findocnet.fi)
    - Research Ethics for Doctoral Students D, LC-L1010 (1-2 ECTS)
    - Open Science for Doctoral Students D, LC-L1011 (1 ECTS)
    - Business Skills for Doctoral Students D, LC-L1012 (1 ECTS)
    - Career Course for Doctoral Students D, LC-L1013 (1 ECTS)
    - Interactive Leadership Skills for Doctoral Students D, LC-L1014 (1 ECTS)

- Project Management for Doctoral Students D, LC-L1015 (1 ECTS)
- Writing Research Grant Applications for Doctoral Students D, LC-L1016 (1 ECTS)
- Pedagogical studies: <https://www.aalto.fi/en/services/pedagogical-training-main-page> (max 20 ECTS)
- Individual study attainments, to be agreed with the supervising professor:

Individual assignment	ECTS	Max amount of ECTS
Assistant for exercises or teaching	1-3 ECTS /course	max 3 courses
Thesis advisor of bachelor's thesis	0,5 ECTS /thesis*	2 ECTS
Thesis advisor of master's thesis	1-3 ECTS /thesis	3 ECTS
Presentations at international conferences	1-2 ECTS / conference	max 3 conferences

\*No half credits are registered, only whole numbers of credits

### Restrictions

- Language courses (ie. Finnish for international students) cannot be included in the degree
- The module cannot consist solely of conference presentations
- The module cannot consist solely of teaching

### Evaluation of the module

No grade is given for the module. Individual courses and study attainments are graded with grades 1-5 or as pass/fail.

### 4.3. Doctoral thesis

The doctoral thesis is written on a topic related to the research field that the doctoral candidate has chosen and that has been approved by the supervising professor and the doctoral programme committee of the School of Electrical Engineering<sup>6</sup>. The thesis shall contribute to new scientific knowledge. The approval of thesis includes a public defence after the pre-examination process. The accepted forms of theses are monographs and article-based doctoral theses. A doctoral thesis is a public document and is kept for public display at the university. All theses works are public in Finland (law 621/1999).

#### Public examination of the doctoral thesis

The doctoral thesis shall be examined and defended at a public examination for which the school determines the date and language and appoints a custos to supervise the examination and one or two opponents after the pre-examination on which you find instructions from the [into.aalto.fi](https://into.aalto.fi) –pages of the programme. The doctoral candidate is provided with an opportunity to comment on the choice of the opponent(s) and the pre-examiners, concerning their impartiality.

The work or works constituting the doctoral thesis shall be on display for public examination for *a minimum of ten days* before the public examination.

The school may issue further provisions on the arrangements and proceedings of the public examination. Please see programme's [into.aalto.fi](https://into.aalto.fi) –pages.

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<sup>6</sup> [Appendix 'Section 43A Degree regulations on doctoral education' in the Aalto University General Regulations on Teaching and Studying \(OOS\).](#)



**Evaluation and grading of the thesis**

The doctoral thesis is graded on the scale of Pass/Fail based on the opponent(s) statement(s) in the doctoral programme committee of the school.