

Curriculum of the Doctoral Programme in Science

Autumn 2018 - Spring 2020

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Basics of the programme

Name of the programme

Perustieteiden tohtorihjelma

Doktorandprogrammet inom teknikvetenskaper

Aalto Doctoral Programme in Science

Extent of the programme:

40 credits + thesis

Language of degree:

The language of the degree can be Finnish, Swedish or English. The language of the degree will be determined individually for every student.

Degrees:

Tekniikan tohtori, Technologie doktor, Doctor of Science (Technology)

Tekniikan lisensiaatti, Technologie licentiat, Licentiate of Science (Technology)

Doctoral programme director:

Professor Tapio Lokki.

The doctoral programme director leads the doctoral programme and is in charge of its planning, implementation, evaluation and development.

Description of the doctoral programme:

The goal of the doctoral programme is professional and high quality doctoral education in the fields of physics, mathematics, biomedical engineering, computer science and industrial engineering. The research fields of the doctoral programme are based on the strong research traditions of the departments. The most important part of the education is the dissertation work done at the departments or under close supervision elsewhere. The dissertation work is supported by the theoretical studies.

The doctoral programme of Science was established 1.1.2011:

<https://into.aalto.fi/display/endofdoctoralsci/Aalto+Doctoral+Programme+in+Science>

Aims of the doctoral degree

The doctoral education prepares the doctoral candidate for an academic career as a highly qualified researcher or, increasingly also for a diversity of career pathways outside the academia in the most demanding expert positions or for becoming an entrepreneur.

The education is carried out in a multidisciplinary international scientific community through research work and through various forms of education and learning methods. The high quality discipline based education and the customized transferrable skills training together with the network-building ensures the development of the doctoral candidate's scientific qualifications along with his/her individually oriented proficiency for working life skills.

The purpose of the doctoral degree is to give the candidate skills for scientific research, skills for applying the knowledge in practice and deeper scientific knowledge, than what the Master's degree did. A central element of the doctoral research work is to get the skills needed for research work and for applying the research results in practice. The doctoral education equips the doctoral candidate with information and skills needed for scientific research and specialist jobs. The degree will give know-how and competences needed for working in different kind of jobs in international environments at all sectors of the society.

The doctoral degree consists of theoretical studies and research work. The main stress is on the scientific research work. Those admitted to doctoral education shall:

1. pursue studies that deal with preparation for scientific work, application of research results and dissemination of research findings
2. gain comprehensive and in-depth knowledge of a research field
3. learn the principles of responsible conduct of research.

Learning outcomes of the doctoral education

Graduated doctors

- have the capability to work in a multidisciplinary and international environment together with various actors.
- have the capability to lead things and / or people.
- have the ability to search and apply knowledge and the ability to use scientific research methods and to create new scientific knowledge.
- are able to publish scientific results in reviewed publications and disseminate the results on scientific forums.
- are able to make such syntheses and critical assessments that are required to solve complex problems in research and innovation and in other areas of society.
- have versatile written and oral communication skills and are able to work and communicate information in several languages.
- work responsibly with respect to ethical and sustainable considerations and their work in the scientific community follows responsible conduct of research.

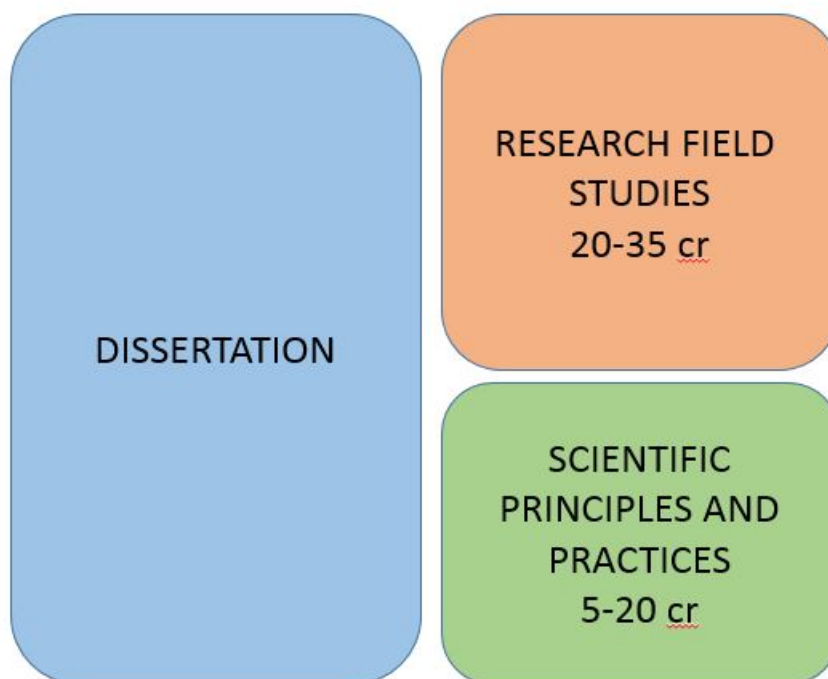
Structure of the doctoral degree

The degree of Doctor of Science (Technology) comprises 40 ECTS of theoretical studies and a dissertation. The duration of full-time studies is four (4) years.

The degree of Licentiate of Science (Technology) comprises 40 ECTS of theoretical studies and a licentiate thesis. The duration of full-time studies is two (2) years.

The doctoral degree comprises the following study modules:

- Research field -module 20 – 35 ECTS
- Scientific practices and principles -module 5 – 20 ECTS
- Dissertation or licentiate thesis



Picture 1. Degree structure

The study modules of the doctoral degree

Both doctoral degrees consist of three modules: dissertation or licentiate thesis, studies in the research field, and studies in scientific practices and principles.

Dissertation

The doctoral dissertation is written on the research field approved for the student. Forms of dissertation approved in the Doctoral Programme in Science are an article-based dissertation, an essay-based dissertation, a monograph, and other work that meets the corresponding scientific criteria.

More detailed guidelines concerning dissertations are confirmed separately by the university. [Formats of and General Quality Requirements for Doctoral Dissertations](#) (AAC 1 December 2015)

A doctoral dissertation is a public document, which shall be on display at the school.

Licentiate thesis

The licentiate thesis is written on the research field approved for the student. In a licentiate thesis, students shall demonstrate good conversance with the field of research and the capability of independently and critically applying scientific research methods.

A licentiate thesis may also be a number of scientific publications or manuscripts vetted for publication deemed sufficient by the university, which deal with the same set of problems and a summary of the findings, or some other work which meets the corresponding scientific criteria.

The thesis may consist of joint publications if the author's independent contribution can be shown.

A licentiate thesis is a public document, which shall be on display at the school.

Studies in the Research field -module 20-35 ECTS

Research field -module should support the writing of the thesis and prepare the students for research and other demanding work that requires expertise.

Students are recommended to take postgraduate-level courses or other such attainments.

The module may include the following:

- Attending postgraduate-level courses in one's own university or another university. Also master-level courses are mostly eligible for the doctoral degree.
- Attainments in scientific summer and winter schools.
- Journal articles and conference papers from the research field written by the student, which are not included in the dissertation (a maximum of 3 x 2 ECTS).
- Self-study (e.g. books, journal or conference articles; written/oral exam/review or a report to demonstrate learning). The textbooks are selected individually for each student according to



his/her study objectives. The professor shall determine the amount of credits according to how extensive and demanding the literature is.

- Writing a literature review
- Refereeing scientific papers

Compulsory courses:

Engineering Physics

Starting from 1 Jan 2013 all new full-time doctoral students in the research field of Engineering Physics must take 'Midterm Review' (10 credits). This is also recommended for part-time students. The course can be included either in the Research field studies or in the Scientific practices and principles -module.

Industrial Engineering and Management:

Starting from 1.8.2018 two of the following three doctoral courses are compulsory for doctoral students in the research field of Industrial Engineering and Management:

- TU-L0010 Advanced Organizational Theory (a joint course with Aalto BIZ and Hanken) (5cr),
- TU-L1002 Doctoral Course in Strategy and Venturing (8cr),
- TU-L2001 Doctoral Course in Operations Management) (5cr)

These courses are included in the Research field -module.

Studies in the Scientific practices and principles -module 5-20 ECTS

The purpose of the studies in Scientific practices and principles -module is to prepare the student for scientific work and introduce him/her to applying and conveying scientific knowledge. The studies should also take into account the needs of the student's future career.

This module may include studies in research methodology, research ethics, history and philosophy of science, and principles of scientific writing. Some of the module may also consist of learning university practices, such as teaching and guidance of research work. Some of the module may include preparatory tasks of a scientific kind related to the research project, or presenting one's research work at a scientific conference. The whole or a part of the module may consist of pedagogical studies.

Language courses cannot be included in the doctoral degree.

The module may include the following:

Scientific work

- Research methodology
- Research ethics



- History and philosophy of science

Conveying scientific knowledge

- Scientific writing
- Courses on communication
- Presentation of one's research work at scientific conferences/conventions in the field (poster or an oral presentation, a maximum of 3 x 2 ECTS)

Learning university practices (teaching and guidance), preparatory tasks of a scientific kind, and pedagogical studies

- Acting as a course assistant, teaching, planning and implementing a new course (a maximum of 6 ECTS)
- Co-supervision/guidance of B.Sc. theses, special assignments, or M.Sc. theses (a maximum of 3 x 2 ECTS)
- Pedagogical studies. Doctoral students can take individual courses or a module up to 25 ECTS. In this case, the maximum amount of 20 ECTS in the Scientific practices and principles -module can be exceeded.

The Scientific practices and principles –module cannot consist solely of conference presentations.

Compulsory courses:

Industrial Engineering and Management

Doctoral students at the research field of industrial engineering and management, who have received the study right after 1 August 2017, must take the following three methodology courses:

- TU-L0000 Research Methods in Industrial Engineering and Management (5cr)
- TU-L0021 Statistical Research Methods (3-6 cr)
- TU-L0031 Qualitative Research Methods (3-6 cr)

Research fields

The Doctoral Programme in Science comprises seven research fields. The departments at the school are in charge of the research fields: Department of Neuroscience and Biomedical Engineering, Department of Mathematics and Systems Analysis, Department of Applied Physics, Department of Computer Science, and Department of Industrial Engineering and Management.

The doctoral student will choose his/her research field when applying to the programme. The student's supervising professor will be confirmed at the same time.



The research fields for 2018-2020 are the following:

- Neuroscience and Biomedical Engineering
- Mathematics
- Theoretical and Applied Mechanics
- Systems and Operations Research
- Applied Physics
- Computer Science
- Industrial Engineering and Management

Research fields and the supervising professors in charge:

Neurotiede ja lääketieteellinen tekniikka
Neurovetenskap och biomedicinsk teknik
Neuroscience and biomedical engineering

Code of the research field: ????

Supervising professors:

Petri Ala-Laurila
 Risto Ilmoniemi
 Ari Koskelainen
 Anton Kuzyk
 Heikki J. Nieminen
 Lauri Parkkonen
 Jukka Tulkki
 Iiro Jääskeläinen
 Riitta Salmelin
 Mikko Sams

Matematiikka
Matematik
Mathematics

Code of the research field: F006Z

Supervising professors:

Alexander Engström
 Antti Hannukainen



Camilla Hollanti
Nuutti Hyvönen
Pauliina Ilmonen
Juha Kinnunen
Riikka Korte
Kaie Kubjas
Kalle Kytölä
Lasse Leskelä

Mekaniikka
Mekanik
Theoretical and Applied Mechanics

Code of the research field: F008Z

Supervising professor:
Rolf Stenberg

Systeemi- ja operaatiotutkimus
System- och operationsanalys
Systems and Operations Research

Code of the research field: F017Z

Supervising professors:

Harri Ehtamo
Ahti Salo
Fabricio Oliveira

Teknillinen fysiikka
Teknisk fysik
Engineering Physics

Code of the research field: SCI019Z

Supervising professors:

Mikko Alava
Tapio Ala-Nissilä



Sebastiaan van Dijken
Christian Flindt
Adam Foster
Pertti Hakonen
Mathias Groth
Olli Ikkala
Matti Kaivola
Esko Kauppinen
Peter Liljeroth
Peter Lund
Jukka Pekola
Martti Puska
Robin Ras
Patrick Rinke
Janne Ruokolainen
Mika Sillanpää
Jaakko Timonen
Filip Tuomisto
Päivi Törmä

Tietotekniikka
Datateknik
Computer Science

Code of the research field: SCIO20

Supervising professors:

N. Asokan
Tuomas Aura
Parinya Chalermsook
Mario Di Francesco
Aristides Gionis
Keijo Heljanko
Eero Hyvönen
Perttu Hämäläinen
Alexander Jung
Juho Kannala
Juha Karhunen
Petteri Kaski
Samuel Kaski
Mikko Kivelä



Jouko Lampinen
Casper Lassenius
Jaakko Lehtinen
Tapio Lokki
Harri Lähdesmäki
Lauri Malmi
Heikki Mannila
David McGookin
Martti Mäntylä
Ilkka Niemelä
Marko Nieminen
Pekka Orponen
Juho Rousu
Jari Saramäki
Lauri Savioja
Kari Smolander
Jukka Suomela
Tapio Takala
Stavros Tripakis
Aki Vehtari
Petri Vuorimaa
Antti Ylä-Jääski

Tuotantotalous
Produktionsekonomi
Industrial Engineering and Management

Code of the research field: SCI022Z

Supervising professors:

Karlos Artto
Marina Biniari
Eero Eloranta
Robin Gustafsson
Jan Holmström
Eila Järvenpää
Mikko Jääskeläinen
Ilkka Kauranen
Paul Lillrank
Markku Maula
Risto Rajala
Esa Saarinen



Henri Schildt
Jens Schmidt
Riitta Smeds
Kari Tanskanen
Matti Vartiainen
Timo Vuori