



The participating faculties and departments at both Aalto University and the University of Helsinki offer a range of courses relating to all aspects of quantum studies.

Students from both universities can sign up for **any of the courses listed below**. Note that the courses listed here are all eligible *QuantEd studies* (studies easily transferable from one university to another) – they are not necessarily in the curriculum every year. When a teaching time is known (as of June 2023), it is given here – “?” means you will need to check Sisu. Tip: the course code is often the easiest way to search for a course.

For instructions on how to combine courses from the two Universities, navigate to instituteq.fi/education or search for instructions on your home institution’s web page.

If you find outdated information, please email: tapio.rasa@helsinki.fi

Courses offered by the University of Helsinki

Code	Name	Credits	Level	Language	Period
BSPH2004	Introduction to Quantum Physics	5	BSc	EN	?
<i>Prerequisites: Mathematical Methods of Physics I-II (or equivalent)</i>					
FYS2003	Kvanttifysiikan perusteet (Basics of / Introduction to Quantum Physics)	5	BSc	FI	IV
<i>Prerequisites: Mathematical Methods of Physics I-II (or equivalent)</i>					
FYS2023	Kvantfysikens grunder	5	BSc	SWE	IV
<i>Prerequisites: Mathematical Methods of Physics I-II (or equivalent)</i>					
BSPH2005	Applications of quantum physics I: atoms and molecules	5	BSc	EN	?
<i>Prerequisites: Introduction to / Basics of Quantum Physics (or equivalent)</i>					
FYS2005	Kvanttifysiikan sovelluksia: Atomit ja molekyylit (Quantum Physics applications I)	5	BSc	FI	?
<i>Prerequisites: Introduction to / Basics of Quantum Physics (or equivalent)</i>					



FYS2025	Kvanttfysikens tillämpningar: Atomer och molekyler	5	BSc	SWE	?
<i>Prerequisites: Introduction to / Basics of Quantum Physics (or equivalent)</i>					
BSPH2006	Applications of quantum physics II: solid state and elementary particles	5	BSc	EN	?
<i>Prerequisites: Applications of Quantum Physics I (or equivalent)</i>					
FYS2006	Kvanttfysiikan sovelluksia: Tiivis aine ja alkeishiukkaset	5	BSc	FI	II
<i>Prerequisites: Applications of Quantum Physics I (or equivalent)</i>					
FYS2026	Kvanttfysikens tillämpningar: Det fasta tillståndet och elementarpartiklar	5	BSc	SWE	II
<i>Prerequisites: Applications of Quantum Physics I (or equivalent)</i>					
CSM14211	Introduction to the Programming of Quantum Computers	5	MSc	EN	?
<i>Prerequisites: basic programming skills</i>					
FILM-312a	Philosophy of Science, Advanced	5	MA	FI	III
<i>Prerequisites: Ask teacher</i>					
FYS2061	Kvanttimekaniikka Ia (Quantum Mechanics Ia)	5	BSc	FI, EN, SWE	I
<i>Prerequisites: Introduction to / Basics of Quantum Physics, Mathematical Methods in Physics IIa (or equivalent)</i>					
FYS2062	Kvanttimekaniikka Ib (Quantum Mechanics Ib)	5	BSc	FI, EN, SWE	II
<i>Prerequisites: Kvanttimekaniikka Ia (Quantum Mechanics Ia), possibly Mathematical Methods in Physics IIb</i>					



Institute



FYS2019	Kvanttistatistiikka (Quantum Statistics)	5	BSc	FI	III
---------	------------------------------------------	---	-----	----	-----

Prerequisites: Quantum Mechanics Ia-Ib, Statistical Mechanics and its prerequisites (or equivalent)

FYS2029	Kvanttilaskenta (Quantum Computing)	5	BSc	FI	IV
---------	-------------------------------------	---	-----	----	----

Prerequisites: Introduction to / Basics of Quantum Physics (or equivalent)

KEM368	Density functional theory	5	MSc	EN	?
--------	---------------------------	---	-----	----	---

Prerequisites: Background knowledge equivalent to Applications of Quantum Physics I

KEM369	Molecular electronic structure	5	MSc	EN	?
--------	--------------------------------	---	-----	----	---

Prerequisites: BSc in chemistry, physics, or related fields.

KEM345	Molecular properties	5	MSc	FI, EN, SWE	II
--------	----------------------	---	-----	-------------	----

Prerequisites: BSc in chemistry, physics, or related fields.

KEM372	Laser Spectroscopy Instrumentation	5	MSc	EN	?
--------	------------------------------------	---	-----	----	---

Prerequisites: basics of molecular structure and electromagnetism (e.g., KEK201 and FYS1015)

KEM365	Laser Spectroscopy	5	MSc	EN	?
--------	--------------------	---	-----	----	---

Prerequisites: Laser Spectroscopy Instrumentation (or equivalent) is recommended

MAST31218	Introduction to Quantum Computation		MSc	EN	?
-----------	-------------------------------------	--	-----	----	---

Prerequisites: BSc level mathematics or equivalent (e.g., Mathematical Methods courses)

MAST31709	Optimal Stochastic Control	5	MSc	EN	?
-----------	----------------------------	---	-----	----	---

Prerequisites: Basic notions of probability theory and stochastic calculus



Institute



MATR303:1	Solid state physics: crystal structure and atomic dynamics	5	MSc	FI, EN, SWE	III
-----------	------------------------------------------------------------	---	-----	-------------	-----

Prerequisites: Introduction to / Basics of Quantum Physics (or equivalent)

MATR303:1	Solid state physics: electronic structure and properties	5	MSc	FI, EN, SWE	IV
-----------	----------------------------------------------------------	---	-----	-------------	----

Prerequisites: MATR303:1

MATR322	Numerical Methods in Scientific Computing	10	MSc	EN	?
---------	-------------------------------------------	----	-----	----	---

Prerequisites: Mathematical Methods courses (or equivalent background with calculus and linear algebra), programming (C/C++/Fortran/Python/Matlab/Octave; see e.g., FYS2085), familiarity with the Linux programming environment

MATR324	Monte Carlo simulations in physics	5	MSc	EN	IV
---------	------------------------------------	---	-----	----	----

Prerequisites: Basics of Monte Carlo Simulations (or equivalent), programming (Fortran/C/C++)

MATR327	Computational nanoscience	10	MSc	FI, EN, SWE	?
---------	---------------------------	----	-----	-------------	---

Prerequisites: Molecular Dynamics Simulations (or equivalent; can be taken at the same time), Solid State Physics, programming (Fortran/C/Python), familiarity with the Linux programming environment; Nanophysics and nanochemistry recommended

PAP346	Path Integral Quantization of Gauge Field Theories	5	MSc	EN	?
--------	----------------------------------------------------	---	-----	----	---

Prerequisites: Quantum Field Theory I-II (or equivalent)

PAP334	Statistical methods	5	MSc	EN	I-II
--------	---------------------	---	-----	----	------

Prerequisites: background in some statistical library or tool (Matlab, Octave, ROOT, etc.)

TCM302	Quantum mechanics IIa	5	MSc	EN	III
--------	-----------------------	---	-----	----	-----

Prerequisites: Quantum mechanics Ib, Electrodynamics I-II, Mathematical methods in physics IIa and IIb (or equivalent)



TCM333	Open Quantum Systems I	5	MSc	EN	I
<i>Prerequisites: Mathematical Methods of Physics Ia-IIb or equivalent, familiarity with some quantum mechanics</i>					
TCM334	Open Quantum Systems II	5	MSc	EN	II
<i>Prerequisites: Open Quantum Systems I</i>					
TCM320	Stochastic Methods A	5	MSc	EN	I
<i>Prerequisites: Mathematical Methods of Physics Ia-IIb (or equivalent)</i>					
TCM321	Stochastic Methods B	5	MSc	EN	II
<i>Prerequisites: Stochastic Methods A</i>					
TCM322	Quantum Information A	5	MSc	EN	I
<i>Prerequisites: Mathematical Methods of Physics Ia-IIb or equivalent, familiarity with some quantum mechanics</i>					
TCM323	Quantum Information B	5	MSc	EN	II
<i>Prerequisites: Quantum Information A</i>					
TCM306	Advanced Statistical Physics	5	MSc	EN	?
<i>Prerequisites: Statistical Mechanics and its prerequisites, or equivalent</i>					



Courses offered by the Aalto University School of Science

Code	Name	Credits	Level	Language	Period
PHYS-C0210	Kvanttimekaniikka	5	BSc	FI, SWE	II

Prerequisites: basic differential equations and integrals, basic equations of motion

PHYS-E0414	Advanced quantum mechanics	5	MSc	EN	I-II
------------	----------------------------	---	-----	----	------

Prerequisites: basic quantum mechanics (Kvanttimekaniikka / Quantum Mechanics or equivalent), some complex analysis, linear algebra

PHYS-E0551	Low Temperature Physics	5	MSc	EN	?
------------	-------------------------	---	-----	----	---

Prerequisites: Advanced Quantum Mechanics, Solid-State Physics (or equivalent)

PHYS-E0420	Many-body Quantum Mechanics (Quantum many-body physics)	5	MSc	EN	III-IV
------------	------------------------------------------------------------	---	-----	----	--------

Prerequisites: Quantum Mechanics, recommended Advanced Quantum Mechanics (or equivalent)

PHYS-E0421	Solid state physics	5	MSc	EN	IV-V
------------	---------------------	---	-----	----	------

Prerequisites: Materiaalifysiikka / Materials Physics (or equivalent)

PHYS-E0436	Modern optics	5	MSc	EN	?
------------	---------------	---	-----	----	---

Prerequisites: Laser Technology and Optics, Optical Physics (or equivalent)

PHYS-E0437	Laser physics	5	MSc	EN	IV-V
------------	---------------	---	-----	----	------

Prerequisites: Laser Technology and Optics, Optical Physics (or equivalent)



Institute



PHYS-E0525	Microscopy of nanomaterials	5	MSc	EN	III-IV
------------	-----------------------------	---	-----	----	--------

Prerequisites: Ask teacher

PHYS-E0549	Machine learning for materials science	5	MSc	EN	I
------------	----------------------------------------	---	-----	----	---

Prerequisites: basic programming (e.g., Python/Matlab/C)

PHYS-C0254	Quantum circuits	5	BSc	EN	IV
------------	------------------	---	-----	----	----

Prerequisites: Basic quantum mechanics, concepts of second quantization, harmonic oscillator, basic solid-state physics (e.g., Quantum Materials)

PHYS-C0258	Quantum Labs	5	BSc	EN	I
------------	--------------	---	-----	----	---

Prerequisites: Quantum Mechanics, Quantum Information, Quantum Circuits (or equivalent)

PHYS-E0412	Computational physics	5	MSc	EN	III-V
------------	-----------------------	---	-----	----	-------

Prerequisites: Ask teacher

Courses offered by the Aalto University School of Electrical Engineering

Code	Name	Credits	Level	Language	Period
------	------	---------	-------	----------	--------

ELEC-C9440	Quantum information	5	BSc	EN	V
------------	---------------------	---	-----	----	---

Prerequisites: ELEC-C9420 Introduction to quantum technology, MS-A0011 Matrix algebra (or equivalent)

ELEC-C9420	Introduction to Quantum Technology	5	BSc	EN	I-II
------------	------------------------------------	---	-----	----	------

Prerequisites: High-school level mathematics: differentiation, integration, vector calculus.



ELEC-E3230	Nanotechnology	5	MSc	EN	IV
<i>Prerequisites: Ask teacher</i>					
ELEC-C9430	Electromagnetism	5	BSc	EN	IV-V
<i>Prerequisites: Differential and integral calculus; basics of classical mechanics</i>					
ELEC-E4130	Electromagnetic Fields	5	MSc	EN	I-III
<i>Prerequisites: Working knowledge of engineering mathematics (vector calculus, complex numbers and integrals) and basic knowledge of electrical circuits and undergraduate electromagnetics (electric and magnetic fields and forces, electromagnetic induction).</i>					
ELEC-E3140	Semiconductor Physics	5	MSc	EN	I-II
<i>Prerequisites: Basic university physics</i>					
ELEC-E3220	Semiconductor Devices	5	MSc	EN	III
<i>Prerequisites: Semiconductor Physics (or equivalent)</i>					
ELEC-E3240	Photonics	5	MSc	EN	III
<i>Prerequisites: None.</i>					
ELEC-E4810	Metamaterials and nanophotonics	5	MSc	EN	I-II
<i>Prerequisites: Basic knowledge of electromagnetic theory (waveguides, radiation) and radio engineering (resonance, transmission lines).</i>					