



Programme syllabus

Master's Programme, Engineering Physics, 120 credits

Masterprogram, teknisk fysik

120.0 credits

Valid for students admitted to the education from autumn 19 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

The overall objective of the Master's programme in Engineering Physics is to educate engineers with a deep knowledge in physics and with a sufficiently deep knowledge in other relevant fields, so that they can participate in the development of future fields of technology. The knowledge of physics and mathematics acquired within the programme, is especially suitable for advanced development work in industry or for continuing with doctoral degree studies. Depending on personal interests, students can choose to specialize within a number of different fields.

Knowledge and understanding

To obtain a degree from the Master's programme in Engineering Physics, the student shall

- show a broad knowledge of physics
- show a deep knowledge within at least one subfield of physics and show a deep knowledge of the scientific methodology used within this subfield
- have a solid basis for continued studies towards a PhD degree in physics or a physics-related subject
- be familiar with advanced problem-solving methods

Skills and abilities

To obtain a degree from the Master's programme in Engineering Physics, the student shall

- show the ability to apply physics and mathematics methods to solve engineering problems, even if these problems are complex and contain limited information

- show the ability to critically, independently and creatively identify and formulate problems in physics, use adequate methods to solve them and document the results in a proper way in order to be able to contribute to the development of knowledge
- show the ability in various contexts to both orally and in writing clearly communicate and discuss the conclusions and the underlying arguments
- be experienced in seeking information from various sources
- be experienced in teamwork and interaction within a group
- show the ability to make use of new information to develop new skills

Ability to make judgements and adopt a standpoint

To obtain a degree from the Master's programme in Engineering Physics, the student shall

- show a responsible attitude towards the use and misuse of science
- be able to correctly consider ethical, societal and sustainability aspects when required
- realize the importance of giving due credit to previous contributions and prior knowledge in a research field
- show the ability to take own responsibility for the continued personal knowledge development

Extent and content of the programme

The programme, which covers 2 years of studies corresponding to 120 university credits, provides a broad basis in physics for all students. The level of education is second cycle. Students can choose tracks in Biomedical Physics, Quantum Technology, Optics and Photonics, Subatomic & Astrophysics and Theoretical Physics.

The language of instruction is English.

Eligibility and selection

General eligibility requirements

- A completed Bachelor's degree, corresponding to a Swedish Bachelor's degree (180 ECTS), or equivalent academic qualifications from an internationally recognised university. Students in their final year of undergraduate education may also apply to KTH and if qualified, receive a conditional acceptance.
- English language proficiency equivalent to (the Swedish upper secondary school) English course B /6. There are different ways to fulfill the English language requirements, see: www.kth.se

Specific eligibility requirements

A Bachelor's degree, or equivalent, corresponding to 180 ECTS credits, with courses in

- Physics (including classical mechanics, thermodynamics, electromagnetism, waves, geometrical optics and quantum mechanics) equivalent to at least 45 ECTS credits.
- Mathematics (including differential and integral calculus, linear algebra, differential equations and transforms, and statistics) equivalent to at least 35 ECTS credits.

Selection process

The selection process is based on the following selection criteria: University ranking and study performance from previous University studies. The evaluation scale is 1-75. The applicant will get a lower evaluation score if the mandatory program-specific summary sheet is missing from the application documents, which also applies to Swedish applicants.

Implementation of the education

Structure of the education

The academic year at KTH starts in end of August/beginning of September and ends in end of May /beginning of June. It is divided into four periods, two in the Autumn and two in the Spring. Each period lasts approximately seven weeks and is followed by an examination period. In addition to the four regular examination periods, there are four additional re-examination periods: before Christmas, in April, immediately after the end of the academic year, and immediately before the start of a new academic year. The academic year has a duration of 40 weeks. Teaching activities may, if necessary, be scheduled outside the academic year.

Courses

The programme is course-based. Lists of courses are included in [appendix 1](#).

The programme consists of three types of courses: compulsory courses, conditionally elective courses and elective courses. Lists of courses for the different programme tracks are given in appendix 1. The compulsory courses amount to approximately 25 credits for each track, and the conditionally elective courses amount to approximately 70 credits. From the list of conditionally elective courses the students must select courses amounting to at least 25 credits. The elective courses can be chosen from all courses listed for all tracks, or, alternatively, the students may suggest other, non-listed, courses that fit in with the track chosen. The choice of elective courses must be approved by the programme director.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

The grades pass (P) and fail (F) are used for thesis works.

Conditions for participation in the programme

For students starting their education from the autumn semester 2018, previous promotion requirements have been replaced with special admission requirements to each course. Admission requirements are specified in the course syllabus.

Course application

As a student at KTH programmes you have to apply for semester courses. The application is done via www.universityadmissions.se

Course registration

Students admitted to an educational programme at KTH must register for the courses they intend to study. Course registration is required for the examination and means that the student is active.

Recognition of previous academic studies

Under certain circumstances, and in agreement with the programme director, credits for previous studies can be received according to the local policy of KTH.

Studies abroad

Students have the opportunity to spend one semester at one of KTH's partner universities abroad.

For more information and recommendation on the appropriate semester for exchange studies refer to the International coordinator.

Degree project

The purpose of the degree project is that the student should demonstrate the ability to perform independent project work, using and developing the skills obtained from the courses in the programme.

The Master thesis work corresponds to 30 credits on advanced level, or about 20 weeks of full time work. The degree project can either be performed at a university or at a company with suitable infrastructure to provide sufficient supervision and resources for the project (or a combination of those). The degree project should be summarised in a written report and presented orally at a seminar. To begin the degree project

- the student has an agreement with an examiner within a research area belonging to the programme
- has fulfilled the special admission requirements for the course.

The student must actively search for a suitable degree project; however KTH will provide some assistance with information on suitable points of contact. The choice of degree project must be approved by the programme director.

The degree project is graded P/F.

Degree

In order to earn Degree of Master of Science in Engineering Physics (120 credits), it is both required that the student has a passing grade in all courses within the programme and that the student's choices of courses are in accordance with the programme goals. The studies must comprise 120 higher education credits which include a degree project consisting of 30 higher education credits, in the second cycle.

KTH's local degree ordinance can be found at KTH's website, www.kth.se.

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



Appendix 1: Course list

Programme syllabus for studies starting in autumn 2019, Master's Programme, Engineering Physics, 120 credits (TTFYM)

General courses

Year 2

Mandatory courses (7.5 Credits)

Code	Name	Credits	Edu. level
AK2030	Theory and Methodology of Science (Natural and Technological Science)	4.5 hp	Second cycle
SH2007	Research Methodology in Physics	3.0 hp	Second cycle

Supplementary information

After consultation with the programme director, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Track, Theoretical Physics (TFYA)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
SI2380	Advanced Quantum Mechanics	7.5 hp	Second cycle
SI2510	Statistical Mechanics	7.5 hp	Second cycle

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
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CB2070	Molecular Quantum Mechanics	7.5 hp	Second cycle
SI1142	Mathematical Methods in Physics, Additional Course	3.0 hp	First cycle
SI1336	Simulation and Modeling	6.0 hp	First cycle
SI2371	Special Relativity	6.0 hp	Second cycle
SI2372	General Relativity	3.0 hp	Second cycle
SI2390	Relativistic Quantum Physics	7.5 hp	Second cycle
SI2400	Theoretical Particle Physics	7.5 hp	Second cycle
SI2520	Nonequilibrium Statistical Mechanics	7.5 hp	Second cycle
SI2530	Computational Physics	7.5 hp	Second cycle
SI2540	Complex Systems	7.5 hp	Second cycle
SI2720	Biophysics	7.5 hp	Second cycle

Supplementary information

At least 25 hp of the conditionally elective courses has to be studied. The listing of conditionally elective courses as belonging to year 1 or year 2 is only indicative. Provided that the students fulfil the prerequisites, the courses can be taken during either year.

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Year 2

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SI2410	Quantum Field Theory	7.5 hp	Second cycle
SI2600	Condensed Matter Theory	7.5 hp	Second cycle

Supplementary information

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses

Track, Subatomic and Astrophysics (TFYB)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
SH2103	Subatomic Physics	7.5 hp	Second cycle
SI2380	Advanced Quantum Mechanics	7.5 hp	Second cycle

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SH2011	Theoretical Nuclear Physics	6.0 hp	Second cycle
SH2203	Experimental Particle Physics	7.5 hp	Second cycle
SH2302	Nuclear Physics	8.0 hp	Second cycle
SH2306	Experimental Techniques for Nuclear and Particle Physics	8.0 hp	Second cycle
SH2314	Medical Imaging, Signals and Systems	7.5 hp	Second cycle
SI2371	Special Relativity <i>Strongly recommended</i>	6.0 hp	Second cycle
SI2390	Relativistic Quantum Physics	7.5 hp	Second cycle
SI2400	Theoretical Particle Physics	7.5 hp	Second cycle

Supplementary information

At least 25 hp of the conditionally elective courses the first and second year has to be studied.

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Year 2

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SH2204	Astroparticle Physics	7.5 hp	Second cycle
SH2306	Experimental Techniques for Nuclear and Particle Physics	8.0 hp	Second cycle
SH2403	Astrophysics, Advanced Course	6.0 hp	Second cycle

Supplementary information

At least 25 hp of the conditionally elective courses the first and second year has to be studied.

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses

Track, Biomedical Physics (TFYE)

Year 1

Mandatory courses (20.0 Credits)

Code	Name	Credits	Edu. level
SK2520	Experimental Methods in Molecular Biophysics	8.0 hp	Second cycle
SK2531	Biomedicine for Engineers	12.0 hp	Second cycle

Optional courses

Code	Name	Credits	Edu. level
HL1007	Medical Engineering, Basic Course	6.0 hp	First cycle
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SH2314	Medical Imaging, Signals and Systems	7.5 hp	Second cycle
SI2530	Computational Physics	7.5 hp	Second cycle
SI2720	Biophysics	7.5 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2512	Cellular Biophysics	10.0 hp	Second cycle
SK2513	Cell Culture: Theory and Practice	4.0 hp	Second cycle
SK2550	X-ray Physics and Applications	6.0 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle

Supplementary information

At least 25 hp of the conditionally elective courses has to be studied. Several courses are listed as conditionally elective for both year 1 and year 2. This means that the students are free to take these courses during either year, as long as the prerequisites are fulfilled (see course descriptions).

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Year 2

Optional courses

Code	Name	Credits	Edu. level
HL1007	Medical Engineering, Basic Course	6.0 hp	First cycle
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SI2530	Computational Physics	7.5 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle

Supplementary information

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses

Track, Optics & Photonics (TFYF)

Year 1

Mandatory courses (13.5 Credits)

Code	Name	Credits	Edu. level
SK2300	Optical Physics	6.0 hp	Second cycle
SK2902	Light-matter Interaction	7.5 hp	Second cycle

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle
SK2771	Solid State Physics <i>For students who hasn't studied Solid State Physics before</i>	5.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SK2320	Problem Solving in Optics	6.0 hp	Second cycle
SK2340	Fourier optics	6.0 hp	Second cycle
SK2350	Optical Measurement Techniques	6.0 hp	Second cycle
SK2402	Fundamentals of Photonics	7.5 hp	Second cycle
SK2403	Applied Photonics	6.0 hp	Second cycle
SK2411	Laser Physics	7.5 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2550	X-ray Physics and Applications	6.0 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle
SK2800	Laser Spectroscopy	8.0 hp	Second cycle
SK2811	Fiber-optical Communication	7.5 hp	Second cycle
SK2900	Quantum Photonics	7.5 hp	Second cycle

Supplementary information

A new compulsory course in Light and materia will be created. Also two new conditionally elective courses in Basics of photnics and Applied photonics will be created.

At least 25 hp of the conditionally elective courses has to be studied. The listing of conditionally elective courses as belonging to year 1 or year 2 is only indicative. Provided that the students fulfil the prerequisites, the courses can be taken during either year.

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Year 2

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SK2320	Problem Solving in Optics	6.0 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle
SK2800	Laser Spectroscopy	8.0 hp	Second cycle
SK2811	Fiber-optical Communication	7.5 hp	Second cycle

Track, Quantum Technology (TFYG)

Year 1

Mandatory courses (15.0 Credits)

Code	Name	Credits	Edu. level
SI2380	Advanced Quantum Mechanics	7.5 hp	Second cycle
SK2903	Quantum Technology	7.5 hp	Second cycle

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle
SK2771	Solid State Physics <i>For students who hasn't studied Solid State Physics before</i>	5.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SI2520	Nonequilibrium Statistical Mechanics	7.5 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle
SK2700	Mesoscopic Physics	8.0 hp	Second cycle
SK2710	Spin Electronics	8.0 hp	Second cycle
SK2759	Superconductivity and Applications	6.0 hp	Second cycle
SK2900	Quantum Photonics	7.5 hp	Second cycle
SK2904	Quantum Materials	7.5 hp	Second cycle

Supplementary information

A new compulsory course in Quantum technology will be created. Even a new conditionally elective course in Quantum materials.

At least 25 hp of the conditionally elective courses has to be studied. The listing of conditionally elective courses as belonging to year 1 or year 2 is only indicative. Provided that the students fulfil the prerequisites, the courses can be taken during either year.

After consultation with the track guide, students may choose appropriate courses from all the course lists of the different tracks. It is also possible, after consultation with the programme director, to choose other, non-listed, courses.

Year 2

Optional courses

Code	Name	Credits	Edu. level
SK2711	Environmental physics	6.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle
SK2905	Superconductivity and other Quantum Liquids	7.5 hp	Second cycle
SK2906	Quantum Circuits	7.5 hp	Second cycle



Appendix 2: Specialisations

Programme syllabus for studies starting in autumn 2019, Master's Programme, Engineering Physics, 120 credits (TTFYM)

Track, Theoretical Physics (TFYA)

The theoretical physics track provides the students with a broad education in fundamental theoretical physics, preparing them for a future as problem solvers or researchers in industry, or for continued PhD studies. The compulsory courses in quantum mechanics and statistical mechanics provide basic theoretical tools that are needed for the more specialised courses. The conditionally elective courses provide tracks towards particle physics, mathematical physics, condensed matter physics and theoretical biological physics. Suitable elective courses can then provide deeper knowledge concerning theoretical and mathematical physics, or experimental physics.

Track, Subatomic and Astrophysics (TFYB)

The subatomic and astrophysics track covers a selection of basic science topics at the front-line of contemporary physics. Both the experimental and theoretical aspects of atomic, nuclear, and particle physics with applications to astrophysics, are included. The application of basic science to real-life problems is illustrated through medical imaging and treatment techniques. The aim of the track is to prepare students for careers at international research facilities, university-based research groups or high-technology industry. The compulsory courses provide a broad orientation in the concepts of subatomic physics, and an advanced discussion of quantum mechanics. The conditionally elective courses allow students to study several fields in more detail, and explore the resulting synergy which is necessary for a fundamental description of the Universe. The elective courses allow students to further focus their studies on a particular research field, broaden their studies within the track, or further explore applications within basic science, industry and society.

Track, Biomedical Physics (TFYE)

In this track knowledge and skills in physics are developed towards applications and research in the life sciences, including biology, chemistry and medicine. Interdisciplinary activities have become increasingly important for the development of new medical diagnostic methods and treatments. Biomedical physics is in the centre of these activities. This track aims at developing the ability of the physicists to interact with the life science disciplines and offers suitable combinations of subjects both for a career in industry as well as for continued studies towards a PhD degree. The need for improvements in the medical field is practically infinite. Through the choice of courses the students can focus on experimental as well as theoretical approaches of biomedical physics, used on different spatial scales, from the molecular and cellular level up to the organ(ism) and population level.

Track, Optics & Photonics (TFYF)

The Optics & Photonics specialisation is important for basic and applied research both in industry and in academia; students with a thorough knowledge of this field find positions as PhD students, development engineers in optics or consultants.

Track, Quantum Technology (TFYG)

The Quantum Technology specialisation trains students within a field which aims to control quantum mechanical states to create novel technological applications; students with this background can become active researchers within an emerging field of physics.