Programme syllabus

Master's Programme, Engineering Physics, 120 credits
Masterprogram, teknisk fysik
120.0 credits

Valid for students admitted to the education from autumn 15 (HT - Autumn term; VT - Spring term).

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

Programme objectives

The aim of this Master of Science programme is to provide students with mathematics and physics skills suitable for advanced development work in industry, as well as for continued PhD studies. Depending on personal interests, students can choose their tracks within a number of different fields.

Knowledge and understanding

After completing the Master of Science program in Engineering Physics the student will:

- have a broad knowledge of physics.
- be able to analyse problems and suggest methods for their solution.
- be able to use appropriate approximations to simplify the solution of a problem.
- have a solid basis for continued studies towards a PhD degree in physics or a physics-related subject.

Skills and abilities

After completing the Master of Science program in Engineering Physics the student will:

- have the ability to apply physics and mathematics methods to solve engineering problems, and to make proper documentation of the results.
- be able to communicate both orally and in writing about technical subjects.
- be experienced in seeking information from various sources.
- be experienced in teamwork and interaction within a group.
- have the ability to make use of new information to develop new skills.

Ability to make judgements and adopt a standpoint

After completing the Master of Science program in Engineering Physics the student will:

- have a responsible attitude towards the use and misuse of science.
- realize the importance of giving due credit to previous contributions and prior knowledge in a research field.
- have an open mind towards accepting good advice and suggestions from different sources.

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, Nano Physics, Optical Physics, Subatomic & Astrophysics and Theoretical Physics.

The language of instruction is English.

Eligibility and selection

Basic eligibility requirements

A completed Bachelor's degree, correspondingto a Swedish Bachelor's degree (180 ECTS), or equivalent academic qualifications from an internationally recognised university. A good knowledge of written and spoken English. Applicants must provide proof of their proficiency in English.

Specific eligibility requirements

Students must have a bachelor's degree (or equivalent) in physics or a physics-related subject, with sufficient theoretical depth, and have obtained good academic results. The specific requirements may be assessed as not fulfilled if the grade point average is below 75% of the scale maximum. Documented skills are required in mathematics (differential and integral calculus, linear algebra, differential equations & transforms, and statistics) and physics (classical and quantum mechanics, electromagnetism, waves, geometrical optics). Physics courses corresponding to at least 45 ECTS are required.

Selection process

The selection process is based on a total evaluation of the following selection criteria: university, GPA, course work related to the programme, motivation letter, working experiences and references. The evaluation scale is 1-75.

Implementation of the education

Structure of the education

The academic year at KTH is divided into four periods. Each period lasts approximately seven weeks with at least 33 days of study. Each period is followed by an examination period. In addition to the four regular examination periods, there are three additional re-examination periods: after Christmas, 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. The total number of credits for courses taken must be at least 90.

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.

Conditions for participation in the programme

When starting the programme, students must choose one of the tracks described in appendix 2. No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration and course selection for the coming term.

At least 45 university credits must be completed during the first academic year (including the re-examination period in August) in order for the student to be promoted to the second year of the programme. Students who fail to fulfill this requirement must together with the programme director and the student counselor make an individual study plan.

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

After approval by the programme director, part of the studies may be carried out abroad (including the Master’s degree project). The condition is that the parts of the programme carried out abroad should fit in with the educational programme.

Degree project

A 30-credit Master’s degree project is carried out at the end of the educational programme (usually the fourth semester). The purpose of the project is to let the student study a problem in more depth than is possible in the courses. The project may be carried out in an academic or industrial environment in Sweden or abroad. To be allowed to start a degree project, a student must have accumulated at least 60 credits.

The choice of project must be approved by the programme director.

The Degree project is graded on a scale from A to F. A-E are passing grades, A is the highest grade.

Degree

Students having completed 120 university credits within the framework of the master's programme in Engineering Physics will receive a degree entitled "Master of Science (Two Years)". Students must apply for the degree and also show proof of their basic degree (bachelor or similar).

The application form for the degree is found at the personal menue at www.kth.se.

Appendix 1 - Course list
Appendix 2 - Programme syllabus descriptions

Appendix 1: Course list

Programme syllabus for studies starting in autumn 2015, 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

Conditionally elective courses

Code	Name	Credits	Edu. level
SI1142	Mathematical Methods in Physics, Additional Course	3.0 hp	First cycle
SI2335	Simulation Physics	6.0 hp	Second 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

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 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.

Year 2

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

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

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
SH2310	Radiation Detectors and Medical Imaging Systems	7.5 hp	Second cycle
SH2500	Atomic and Molecular Physics	6.0 hp	Second cycle
SI2371	Special Relativity *Strongly recommeded*	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 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.

Year 2

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.

Track, Optical Physics (TFYC)

Year 1

Mandatory courses (13.5 Credits)

Code	Name	Credits	Edu. level
SK2300	Optical Physics	6.0 hp	Second cycle
SK2411	Laser Physics	7.5 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
IM2660	Solid State Physics	7.5 hp	Second cycle
SK2301	Optical Physics	3.0 hp	Second cycle
SK2320	Problem Solving in Optics	6.0 hp	Second cycle
SK2330	Optical Systems Design	6.0 hp	Second cycle
SK2340	Fourier optics	6.0 hp	Second cycle
SK2350	Optical Measurement Techniques	6.0 hp	Second cycle
SK2400	Quantum Electronics with Electro Optics	12.0 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

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 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.

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
IM2660	Solid State Physics	7.5 hp	Second cycle
SK2301	Optical Physics	3.0 hp	Second cycle
SK2320	Problem Solving in Optics	6.0 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2800	Laser Spectroscopy	8.0 hp	Second cycle

Track, Nanophysics (TFYD)

Year 1

Mandatory courses (16.0 Credits)

Code	Name	Credits	Edu. level
SK2700	Mesoscopic Physics	8.0 hp	Second cycle
SK2710	Spin Electronics	8.0 hp	Second cycle

Conditionally elective courses

Code	Name	Credits	Edu. level
IM2660	Solid State Physics	7.5 hp	Second cycle
IM2661	Superconductivity and Applications	6.0 hp	Second cycle
SI2380	Advanced Quantum Mechanics *Strongly recommeded*	7.5 hp	Second cycle
SI2510	Statistical Mechanics	7.5 hp	Second cycle
SI2520	Nonequilibrium Statistical Mechanics	7.5 hp	Second cycle
SI2530	Computational Physics	7.5 hp	Second cycle

SK2400	Quantum Electronics with Electro Optics	12.0 hp	Second cycle
SK2560	Nanophotonics and Bionanophotonics	7.5 hp	Second cycle
SK2740	Introduction to Scanning Probe Microscopy	6.0 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).

Among the conditionally elective courses there are three that can be studied at Stockholm University: FK3004 Cond. Mat. Physics, 7,5 hp (as an alt. to IM2660), FK7018 Nanotechnology, 7,5 cr and FK7019 Superconductivity, 7,5 cr (as an alt. to IM2661).

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.

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
IM2660	Solid State Physics	7.5 hp	Second cycle
IM2661	Superconductivity and Applications	6.0 hp	Second cycle
SI2380	Advanced Quantum Mechanics	7.5 hp	Second cycle
SI2510	Statistical Mechanics	7.5 hp	Second cycle
SI2530	Computational Physics	7.5 hp	Second cycle
SI2600	Condensed Matter Theory	7.5 hp	Second cycle

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

Conditionally elective courses

Code	Name	Credits	Edu. level
HL1007	Medical Engineering, Basic Course	6.0 hp	First cycle
SH2310	Radiation Detectors and Medical Imaging Systems	7.5 hp	Second cycle

SI2530	Computational Physics	7.5 hp	Second cycle
SI2550	Membranes and Soft Matter	7.5 hp	Second cycle
SI2700	Protein Physics	7.5 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2510	Cellular Biophysics I	8.0 hp	Second cycle
SK2511	Cellular Biophysics II	6.0 hp	Second cycle
SK2521	Fluorescence Spectroscopy for Biomolecular Studies	6.0 hp	Second cycle
SK2540	Physics and Applications of Ultrasound	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

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 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.

Year 2

Conditionally elective courses

Code	Name	Credits	Edu. level
HL1007	Medical Engineering, Basic Course	6.0 hp	First cycle
SI2530	Computational Physics	7.5 hp	Second cycle
SK2500	Physics of Biomedical Microscopy	6.0 hp	Second cycle
SK2521	Fluorescence Spectroscopy for Biomolecular Studies	6.0 hp	Second cycle

Appendix 2: Specialisations

Programme syllabus for studies starting in autumn 2015, 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, Optical Physics (TFYC)

Optical physics is important in basic and applied research, as well as in industrial applications. Students with a good knowledge in this field are much sought after as PhD students, as well as for positions in industry and consulting. The compulsory courses will provide a good knowledge of optics and laser physics, thereby providing a good foundation for many of the other courses. Many courses provide skills in practical problem solving, which prepares the students for independent research and development work.

Track, Nanophysics (TFYD)

Nano physics is of fundamental importance in a broad spectrum of technological applications. In this track a number of highly interesting current fields are treated, such as nano structures, nano magnetism & spin

electronics, superconductivity and other phenomena with very special properties. The students will receive a good basic education suitable for a career in high-technology industry, as well as for continued studies towards a PhD degree.

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.