Programme syllabus

Master's Programme, Aerospace Engineering, 120 credits
Masterprogram, flyg- och rymdteknik
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 main objective of the programme is to educate skilled engineers for the European aerospace industry and research institutions. The programme is mainly enrolling (but not exclusively) Swedish students and students from European universities with which KTH has exchange agreements. Many different KTH departments contribute to the education with leading expertise in their respective areas of research. The Department of Aeronautical and Vehicle Engineering coordinates the programme and contributes with about half of the courses.

To qualify for the degree of Master of Science in Aerospace Engineering the student shall be able to:

Knowledge and understanding

- demonstrate broad knowledge and understanding of the scientific basis and proven experience of aerospace engineering and deeper insight into current research and development work;
- demonstrate deeper methodological knowledge and understanding in some areas of aerospace engineering, particularly in the chosen area of specialization (aeronautics, lightweight structures, space or systems engineering).

Skills and abilities

- demonstrate ability to, from a holistic perspective, critically, independently and creatively identify, formulate and deal with complex issues and situations in aerospace engineering;
- demonstrate ability to plan and carry out advanced engineering tasks and critically evaluate various technical solutions for aerospace vehicles and other complex technical systems;
- demonstrate ability to plan, perform and evaluate basic experimental testing in order to investigate the validity of a theoretical model
- demonstrate the skills required to participate in research and development work or to work independently in other advanced contexts so as to contribute to the development of knowledge;
- demonstrate ability to critically and systematically integrate knowledge;
- demonstrate ability to model, simulate, predict and evaluate the technical characteristics of aerospace vehicles and other related systems, even on the basis of limited information
- demonstrate ability to design aerospace vehicles and other technical systems and related processes taking into account people’s situations and needs, and the society’s objectives for economically, socially and ecologically sustainable development;
- demonstrate ability to engage and contribute in teamwork and cooperation in groups of varying composition;
- demonstrate ability to clearly present and discuss engineering conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts;

Ability to make judgements and adopt a standpoint

- demonstrate ability to make sound judgements in the design and assessment of aerospace vehicles and other technical systems, taking into account relevant scientific, social, ethical, economic and environmental aspects;
- demonstrate awareness of and insight in the potential and limitations of technology and science, its role in society and people’s responsibility for how it is used;
- demonstrate ability to identify their need for further knowledge and to take responsibility for continuously upgrading personal knowledge and capabilities.

Extent and content of the programme

Aerospace Engineering is a two-year (120 university credits) master programme on the advanced level (second cycle). The instruction language is entirely in English. The programme consists of a basic curriculum followed by four different specializations/tracks in aeronautics, space, lightweight structures or systems engineering. The courses in the basic curriculum are compulsory and constitutes about one third of the course work. In each specialization there is an additional set of compulsory courses to ensure that the students are qualified to perform a final Master's degree project, Second cycle, 30 university credits.

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

- Mathematics: must include (i) calculus in several variables, (ii) algebra, (iii) numerical methods, (iv) differential equations and transforms, and (v) basic control theory, equivalent to at least 25 ECTS credits in total.
- Applied mechanics: must include (i) rigid body mechanics, (ii) solid mechanics, (iii) fluid mechanics and (iv) thermodynamics, equivalent to at least 20 ECTS credits in total.

S**election 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 is divided into four periods. Each period lasts approximately seven weeks with at least 33 days of study. Each period is followed by an exam period consisting of two extra days and at least five exam days. In addition to the four regular exam periods, there are three additional re-examination periods: after Christmas, after May and immediately preceding the first study period of the academic year.

The academic year lasts for a duration of 40 weeks. Teaching activities may, if necessary, be scheduled outside the academic year.

In order to give a broad and interesting introduction to the field, the first semester consists of one introductory course in each major discipline (aeronautics, space, lightweight structures and systems engineering, respectively). The second semester offers a number of more advanced courses, that depends on the chosen specialization. Finally, the second year mainly consists of elective courses and the final degree project, second cycle, 30 university credits.

Courses

The programme is course-based. Lists of courses are included in appendix 1.

The basic curriculum adds up to 35 university credits. In each track, there is an additional set of two, three or four compulsory courses, corresponding to approximately 25 university credits. This leaves approximately 30 university credits for optional (elective) courses. The optional courses should be on the advanced level, and preferably be related to aerospace engineering.

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.

Course application

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

Students admitted to the programme are required to perform an independent study in the form of a degree project corresponding to 30 university credits, second cycle. The project work may begin when special admission requirements for the course are fulfilled.

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 degree project can either be performed at a university or, more commonly, at a company in the aerospace sector with suitable infrastructure to

provide sufficient supervision and resources for the project. The student must actively search for a suitable degree project; however KTH will provide some assistance with information on suitable points of contact. Exchange students are recommended to find a degree project in their country of permanent residence or in the country where they intend to start their professional careers.

Degree

In order to earn Degree of Master of Science in Aerospace engineering(120 credits), passing grades in all courses which are included in the student’s study plan are required. The study plan 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.

Application for degree certificate

Students shall apply for a degree through the web service by logging into your Personal menu/Applications for degrees at www.kth.se

Appendix 1 - Course list
Appendix 2 - Programme syllabus descriptions

Appendix 1: Course list

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

General courses

Year 1

Mandatory courses (35.0 credits)

Course code	Course name	Credits	Edu. level
AK2030	Theory and Methodology of Science (Natural and Technological Science)	4.5	Second cycle
SD2411	Lightweight Structures and FEM	8.0	Second cycle
SD2601	Fundamentals of Flight	7.5	Second cycle
SD2900	Fundamentals of Spaceflight	7.5	Second cycle
SF2863	Systems Engineering	7.5	Second cycle

Supplementary information

Theory and Methodology of Natural and Technological Science: the course SD2900 Fundamentals of Spaceflight, 7,5 credits, contents 3 credits of applied methodological theory – and with the course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits - the courses together content 7,5 credits of theory and methodology of natural and technological science.

The course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits, is given in several study periods during the academic year. If you want to read the course another study period - please ask the Course Responsible if it is possible.

Year 2

Supplementary information

Mandatory course, Study Year 2, Spring semester: Degree project, Second cycle, 30 credits, a independant project within the track/specialisation:

- **Aeronautics: SD281X.** Track responsible: Ulf Ringertz
- **Lightweight Structures: SD241X.** Track responsible: Stefan Hallström
- **Space: EF233X.** Track responsible: Nickolay Ivchenko
- **Systems Engineering: SF281X.** Track responsible: Per Enqvist

Aeronautics (FLT)

Year 1

Mandatory courses (19.5 credits)

Course code	Course name	Credits	Edu. level
AK2030	Theory and Methodology of Science (Natural and Technological Science)	4.5	Second cycle
SD2801	Aircraft Aerodynamics	6.0	Second cycle
SD2805	Flight Mechanics	9.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
EL2520	Control Theory and Practice, Advanced Course	7.5	Second cycle
SD2905	Human Spaceflight	7.5	Second cycle
SD2910	Spacecraft Dynamics	9.0	Second cycle
SG2212	Computational Fluid Dynamics	7.5	Second cycle
SG2215	Compressible Flow	7.5	Second cycle

Supplementary information

The course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits, is given in several study periods during the academic year. If you want to read the course another study period - please ask the Course Responsible if it is possible.

Year 2

Mandatory courses (9.0 credits)

Course code	Course name	Credits	Edu. level
SD2810	Aeroelasticity	9.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
EH2720	Management of Projects	7.5	Second cycle
MJ2241	Jet Propulsion Engines, General Course	6.0	Second cycle

Supplementary information

Mandatory course, Study year 2, Spring semester: Degree project, Second cycle, 30 credits, within the track /specialisation: Aeronautics: SD281X. Trackresponsible: Ulf Ringertz.

Lightweight Structures (LKR)

Year 1

Mandatory courses (16.5 credits)

Course code	Course name	Credits	Edu. level
AK2030	Theory and Methodology of Science (Natural and Technological Science)	4.5	Second cycle
SD2413	Fibre Composites - Analysis and Design	6.0	Second cycle
SD2414	Fibre Composites - Materials and Manufacturing *For students who has not done Degree project, first level, in Lightweight Structures.*	6.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
SD2432	Lightweight Design *The course starts in spring semester (10cr) and continues in autumn semester (10cr).*	20.0	Second cycle
SE2139	Fracture Mechanics	6.0	Second cycle

Supplementary information

Course SE2139 replaces course SE2129

The course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits, is given in several study periods during the academic year. If you want to read the course another study period - please ask the Course Responsible if it is possible.

Year 2

Mandatory courses (12.0 credits)

Course code	Course name	Credits	Edu. level
SD2415	Process Modelling for Composite Manufacturing	6.0	Second cycle
SD2416	Structural Optimisation and Sandwich Design	6.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
EH2720	Management of Projects	7.5	Second cycle
HL2035	Biomechanics and Neuronics	7.5	Second cycle
SD2432	Lightweight Design	20.0	Second cycle
SD2810	Aeroelasticity	9.0	Second cycle

Supplementary information

About course SD2432: The course starts in spring semester (10cr) and continues in autumn semester (10cr).

Mandatory course, Study Year 2, Spring semester: Degree project, Second cycle, 30 credits, within the track /specialisation: Structures: SD241X. Track responsible: Stefan Hallström.

Year 3

Space (RMD)

Year 1

Mandatory courses (16.5 credits)

Course code	Course name	Credits	Edu. level
AK2030	Theory and Methodology of Science (Natural and Technological Science)	4.5	Second cycle
SD2910	Spacecraft Dynamics	9.0	Second cycle
SD2920	System Integration for Space Technology, Part 1	3.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
AH2923	Global Navigation Satellite Systems (GNSS)	7.5	Second cycle
EL2520	Control Theory and Practice, Advanced Course	7.5	Second cycle
MJ2246	Rocket Propulsion	6.0	Second cycle
SD2805	Flight Mechanics	9.0	Second cycle
SD2905	Human Spaceflight	7.5	Second cycle
SG2215	Compressible Flow	7.5	Second cycle
SH1003	Introductory Astronomy for Engineers	7.5	First cycle

Supplementary information

Optional project courses for the student satellite MIST. In addition to the recommended optional courses below, the courses EF2227, EF2228, SD2820 and SD2930 are offered. They all last a full semester and are given both autumn and spring. The only difference is the number of credits, varying from 7.5 to 15.

The course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits, is given in several study periods during the academic year. If you want to read the course another study period - please ask the Course Responsible if it is possible.

Year 2

Mandatory courses (15.0 credits)

Course code	Course name	Credits	Edu. level
EF2240	Space Physics	6.0	Second cycle
EF2260	Space Environment and Spacecraft Engineering	6.0	Second cycle
SD2925	System Integration for Space Technology, Part 2	3.0	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
AG1321	Remote Sensing Technology	7.5	First cycle
EF2200	Plasma Physics	6.0	Second cycle
EF2245	Space Physics II	7.5	Second cycle
EH2720	Management of Projects	7.5	Second cycle
EL2620	Nonlinear Control	7.5	Second cycle

Supplementary information

Mandatory course, Study Year 2, Spring semester: Degree project, Second cycle, 30 credits, within the track /specialisation: Space: EF233X. Track responsible: Nickolay Ivchenko.

Year 3

Systems Engineering (SYS)

Year 1

Mandatory courses (15.0 credits)

Course code	Course name	Credits	Edu. level
EL2520	Control Theory and Practice, Advanced Course	7.5	Second cycle
SF2822	Applied Nonlinear Optimization	7.5	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
EL2450	Hybrid and Embedded Control Systems	7.5	Second cycle
SD2905	Human Spaceflight	7.5	Second cycle
SF2842	Geometric Control Theory	7.5	Second cycle

Conditionally elective courses

Course code	Course name	Credits	Edu. level
SF2812	Applied Linear Optimization *Entry requirements: a Course in Optimization.*	7.5	Second cycle

Supplementary information

The course SF2812 Applied Linear Optimization, 7,5hp/credits - Entry requirements: a Course in Optimization: SF1811 Optimization, 6hp/credits, in Autumn study period 2 **in English**. (SF1861 Optimization, 6hp/credits, in Spring study period 4 in Swedish).

The compulsory course SF2852 Optimal Control Theory, 7.5 credits is taken by batch 17 in year 2, the academic year 2018/2019, period 1. Batch 16 took the compolsury course SF2852 Optimal Control Theory 7.5 credits, grade 1, academic year 2016/2017, period 4

The course AK2030 Theory and Methodology of Science (Natural and Technological Science) 4,5 credits, is given in several study periods during the academic year. If you want to read the course another study period - please ask the Course Responsible if it is possible.

Students have the opportunity to choose between courses SF2812 and SF2822 as a compulsory course.

Year 2

Mandatory courses (37.5 credits)

Course code	Course name	Credits	Edu. level
SF281X	Degree Project in Systems Engineering, Second Cycle	30.0	Second cycle
SF2852	Optimal Control Theory	7.5	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
EH2720	Management of Projects	7.5	Second cycle
EL2620	Nonlinear Control	7.5	Second cycle
EL2820	Modelling of Dynamical Systems	7.5	Second cycle

Course code	Course name	Credits	Edu. level
SF2832	Mathematical Systems Theory	7.5	Second cycle
SF2866	Applied Systems Engineering	7.5	Second cycle

Supplementary information

Mandatory course, Study Year 2, Spring semester: Degree project, Second cycle, 30 credits, within the track /specialisation: Systems: SF281X. Track responsible: Per Enqvist.

Appendix 2: Specialisations

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

Aeronautics (FLT)

The aeronautics track focuses on modeling, analysis and design of aircraft. The overall objectives are that the student should be able to design and estimate the performance of an aircraft, compute its aerodynamic properties, simulate its motion in flight, and analyze how the aerodynamic and structural properties influence stability and control. The track is characterized by a strong interaction between theory and practice, and the student will plan, perform and evaluate several wind tunnel tests during the education. An engineer with this profile is particularly attractive to companies working in aerodynamics and aeronautics.

Lightweight Structures (LKR)

The Lightweight Structures track focuses on analysis and development of lightweight materials and structures for more efficient solutions and products. Reduced structural weight can be used for improved structural efficiency, more cost effective production and maintenance, and reduced environmental impact. Emphasis is put on fiber composites, non-metallic materials and sandwich structures, often used in applications with extreme requirements. Students following the track develop knowledge and skills in analysis, design, optimization, materials, manufacturing and testing of lightweight structures. Design of fibre composites call for a systems approach to the choice of materials, manufacturing processes and product solutions, preparing students for future roles as engineers working with development of new products or applications. There is a constant need for skilled structural engineers within aerospace-, naval- and automotive engineering, as well as in smaller businesses working with e.g. more niched manufacturing or innovative design solutions.

Space (RMD)

Space technology plays a key role in modern society, enabling telecommunication and navigation services, weather forecasting, Earth observation and much more. The space track focuses on applications related to rocket and satellite technology, with particular emphasis on propulsion, trajectory analysis, spacecraft dynamics and system perspective. The space environment and its impact on the design and instrumentation of satellites is another central theme in the education. Wider perspective is offered by courses in human spacecraft, space research etc. The space track can conveniently be combined with (parts of) the other tracks in the program to create an attractive competence profile. As a space engineer you can for example work with development, testing and operation of satellites, launchers, sounding rockets or other space systems.

Systems Engineering (SYS)

Aircrafts, trains and satellites are examples of complex systems that have to be designed with reliable controlsystems and efficient maintenance plans to be competitive in today's global market. The overallobjective with the systems track is that you should be able to develop mathematical models ofsystems in order to analyze and optimize their performance. Control theory had a crucial role in thedevelopment of rockets, and has since improved robustness and performance of modern airplanes. Today, it is becoming an increasingly important factor in other areas such as the automotive industryand communications systems. A systems engineer could be working with the design of the control ofthe damping in an aircraft landing gear, or on how to find the least costly spare parts managementsystem or analyzing the reliability of a radar system. A systems engineer is attractive to a largenumber of industries in various fields.