Programme syllabus

Master's Programme, Engineering Design, 120 credits
Masterprogram, industriell produktutveckling
120.0 credits

Valid for students admitted to the education from autumn 20 (HT - Autumn term; VT - Spring term).

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

Programme objectives

Graduates from the programme Engineering Design shall:

Knowledge and understanding

- demonstrate knowledge of the product development and mechanical engineering field's scientific foundation and proven experience,
- have good insight into current research and development as well as industrial development trends,
- possess good knowledge of the processes, methods and tools for developing technical products,
- have good knowledge of technical systems composed of heterogeneous technologies
- have good knowledge of the interactive properties of technical products and the interaction between technical systems, humans and the surrounding environment,
- be proficient in methods for developing ecologically and economically sustainable products,
- have a good grounding in natural and engineering sciences with a second-cycle specialisation in machine design, mechatronics or internal combustion engines

Skills and abilities

- demonstrate the ability to perform innovative and professional product development work
- demonstrate the ability to, through applying a holistic approach, integrate knowledge, critically and independently define and creatively identify, formulate and manage complex phenomena, issues and situations,
- demonstrate the ability to create technical solutions that meet the needs of humankind and society,
- demonstrate the ability to critically, independently and creatively plan and, using adequate methods and tools, create relevant products, processes and systems within predetermined timeframes and thereby contribute to the development of knowledge, and also evaluate this work,
- demonstrate the ability to critically and systematically integrate knowledge, as well as the ability to define, model, simulate, predict and evaluate the behaviour and performance of heterogeneous technical systems, even with limited or significant quantities of irrelevant information,
• take responsibility for and demonstrate the ability to actively contribute to effective teamwork and collaboration in groups with various constellations of individuals,
• demonstrate the ability to clearly present, orally and in writing, and discuss their conclusions and the knowledge and arguments that form the basis for these, in dialogue with different groups, both in a national and an international context
• demonstrate the skill required to participate in research and development work or to work independently in other advanced technical contexts.

Ability to make judgements and adopt a standpoint

• demonstrate the ability to perform assessments while taking into account relevant scientific, societal and ethical aspects, and demonstrate awareness of ethical aspects of research and development work,
• demonstrate insight into the possibilities and limitations of technology, its role in society and the responsibility of human beings for how it is used, including social and economic aspects as well as environmental and work environment aspects,
• have a particularly good understanding of the inherent complexity of technical systems and of the fact that the process of developing them is often incompletely defined and involves conflicting requirements and expectations,
• be aware and show a keen understanding of the responsibility and the ethical standpoints that need to be assumed during technical product development,
• demonstrate the ability to identify their need of further knowledge and to continuously develop their skills.

Extent and content of the programme

The programme comprises 120 credits, which corresponds to two years of full-time studies. The programme is in the second cycle and the language of instruction is English.

The programme consists of three tracks:

• Machine Design
• Mechatronics
• Internal Combustion Engines

Eligibility and selection

In addition to the general entry requirements at KTH, the following programme-specific requirements apply:

• A completed Degree of Bachelor in mechanical engineering or equivalent, with sufficient theoretically depth and good academic results. The degree must be equivalent to a Swedish Degree of Bachelor (180 credits) or equivalent academic qualifications from an internationally recognised university
• English course B/English course 6.

For an application to be considered, the applicant shall also specify their choice of programme track. Documented proficiency in the following track-specific courses or equivalent is required:
The track Mechatronics requires courses in

- Programming and Computer Science
- Automatic Control
- Electrical Engineering: analogue and digital technology, electric motors and fundamental microprocessor technology

The track Internal Combustion Engines requires courses in

- Thermodynamics (6 ECTS)
- Automatic Control (6 ECTS)
- Electrical Engineering (6 ECTS)

The selection process is based on the following criteria: university, credits awarded (e.g. grades, grades in specific subjects and English), motivation for the studies (for instance, letter of motivation, references, courses and relevant professional experience). The assessment of qualifications scale is 1-75.

**Implementation of the education**

**Structure of the education**

**Academic year**
Each academic year consists of two semesters which are 20 weeks each. Each semester is divided into two study periods.

**Structure of the programme**
The programme structure is adapted to allow for the possibility of a Degree of Master of Science in Engineering (within “Design and Product Realisation”, “Vehicle Engineering” or “Mechanical Engineering”), and/or a Degree of Master in Engineering Design.

The programme includes a common course package that is both research preparatory and provides a solid base for the three tracks – Internal Combustion Engines, Machine Design and Mechatronics.

The programme concludes with a second-cycle degree project of 30 credits during semester 4.

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

The programme consists of compulsory, conditionally elective, recommended and optional courses. The compulsory courses are defined for each year and track/profile in course lists. The goals, entrance qualifications, content and course requirements for each course can be found in the official course syllabuses. Choice of track is specified when applying to the programme.

The type of instruction and examination format vary between the courses and these are indicated in each official course syllabus.
The optional courses can be chosen from KTH's range of offered courses. Credits from courses at other universities/higher education institutions can also be transferred if the qualification requirements are met.

The following limitations apply to the optional courses:

- There is a limit imposed on the number of credits that may be chosen per semester
- An optional course may not correspond to a significant extent to an existing programme course or an already credited course
- Higher education preparatory courses may not be counted as optional courses
- Optional courses may be chosen freely but should be relevant to the professional role of engineer.

**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.

Grading scale is found in the course syllabus.

**Conditions for participation in the programme**

Participation requires admission to courses within the programme and course registration.

For studies at a higher study year there are specific admission requirements for the courses. Admission requirements are specified in the course syllabus.

**Degree project**

**Degree project, second cycle**

The programme includes a degree project for a Degree of Master that comprises 30 credits.

In order to fulfill specific admission requirements for a Degree Project, Second Cycle, 30 credits, courses corresponding to at least 60 credits, second cycle, must be completed. The courses at the second cycle shall include courses in the programme relevant to the degree project, as well as courses in science theory and research methodology.

**Degree**

**Conditions for a Degree of Master, 120 credits**

A Degree of Master of Science is obtained after completing the degree programme. The programme is designed so that the student, when they graduate, has fulfilled the national qualification requirements with a passing grade in all courses included in the student's study plan of 120 credits, of which

- at least 90 credits are attained in the second cycle, which includes at least 60 credits (including a 30 credit degree project) of specialised studies within the programme's main field of study.
Title of general qualification at second cycle
Degree of Master of Science (120 credits), Teknologie masterexamen

Appendix 1 - Course list
Appendix 2 - Programme syllabus descriptions
Appendix 1: Course list

Master's Programme, Engineering Design, 120 credits (TIPUM), Programme syllabus for studies starting in autumn 2020

Track, Combustion Engineering (IPUA)

Year 1

Mandatory courses (25.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2036</td>
<td>Theory and Methodology of Science with Applications (Natural and Technological Science)</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2030</td>
<td>Mechatronics basic Course</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2047</td>
<td>Internal Combustion Engines 1</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SD2125</td>
<td>Signals and Mechanical Systems</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Optional courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL1000</td>
<td>Automatic Control, General Course</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>EL1010</td>
<td>Automatic Control, General Course</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>EL2820</td>
<td>Modelling of Dynamical Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF1025</td>
<td>Model Based Product Development II</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>MF1026</td>
<td>Model Based Product Development I</td>
<td>9.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>MJ1401</td>
<td>Heat Transfer</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
<tr>
<td>SG1217</td>
<td>Fluid Mechanics, Basic Course</td>
<td>6.0 hp</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Conditionally elective courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EJ2410</td>
<td>Hybrid Vehicle Drives</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>KE2051</td>
<td>Environmental Catalysis</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
ME2163 Leading People and Organizations in Different Contexts 6.0 hp  Second cycle
MF2007 Dynamics and Motion Control 9.0 hp  Second cycle
MF2010 Component Design 6.0 hp  Second cycle
MF2018 Tribology 6.0 hp  Second cycle
MF2019 CAD 3D-modelling and Visualization 6.0 hp  Second cycle
MF2043 Robust Mechatronics 6.0 hp  Second cycle
MF2083 Internal Combustion Engines 2 9.0 hp  Second cycle
MF2103 Embedded Systems for Mechatronics 9.0 hp  Second cycle
MJ2429 Turbomachinery 6.0 hp  Second cycle
MJ2430 Thermal Turbomachinery 6.0 hp  Second cycle
SD2222 Vehicle Components 8.0 hp  Second cycle
SD2225 Ground Vehicle Dynamics, Basic Course 11.0 hp  Second cycle
SG2212 Computational Fluid Dynamics 7.5 hp  Second cycle
SG2214 Fluid Mechanics 7.5 hp  Second cycle
SG2215 Compressible Flow 7.5 hp  Second cycle
SG2218 Turbulence 7.5 hp  Second cycle
SG2219 Advanced Compressible Flows 7.5 hp  Second cycle
SG2224 Applied Computational Fluid Dynamics 5.0 hp  Second cycle

Supplementary information

The sum of conditionally elective courses should be at least 20 credits.

Year 2

Mandatory courses (48.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2066</td>
<td>Internal Combustion Engines Advanced Course</td>
<td>18.0 hp  Second cycle</td>
</tr>
<tr>
<td>MF225X</td>
<td>Degree Project in Internal Combustion Engineering, Second Cycle</td>
<td>30.0 hp  Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

The course list is based upon the curriculum for academic year 2020/2021. Changes may occur.

Track, Machine Design (IPUB)

Year 1

Mandatory courses (51.0 Credits)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2010</td>
<td>Component Design</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2011</td>
<td>Systems Engineering</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2018</td>
<td>Tribology</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2024</td>
<td>Robust and Probabilistic Design</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2054</td>
<td>Modell-Based Design, Adaption Course</td>
<td>3.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2068</td>
<td>Machine Dynamics</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2076</td>
<td>Machine Design Advanced Course Part I</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2101</td>
<td>Machine Design</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

**Supplementary information**

**Year 2**

**Mandatory courses (48.0 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2072</td>
<td>Research Methodology in Machine Design</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2077</td>
<td>Machine Design Advanced Course Part II</td>
<td>12.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF223X</td>
<td>Degree Project in Machine Design, Second Cycle</td>
<td>30.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

**Supplementary information**

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**Track, Mechatronics (IPUC)**

**Year 1**

**Mandatory courses (42.0 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2007</td>
<td>Dynamics and Motion Control</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2030</td>
<td>Mechatronics basic Course</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2043</td>
<td>Robust Mechatronics</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2058</td>
<td>Mechatronics, Advanced Course Spring Semester</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2095</td>
<td>Programming in C for Embedded Systems</td>
<td>3.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2103</td>
<td>Embedded Systems for Mechatronics</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
Supplementary information

Year 2

Mandatory courses (49.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF2059</td>
<td>Mechatronics, Advanced Course, Fall semester</td>
<td>15.0 hp</td>
<td>Second cycle</td>
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<tr>
<td>MF2071</td>
<td>Research Methodology in Mechatronics</td>
<td>4.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF224X</td>
<td>Degree Project in Mechatronics, Second Cycle</td>
<td>30.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

The course list is based upon the curriculum for academic year 2020/2021. Changes may occur.
Appendix 2: Specialisations

Master's Programme, Engineering Design, 120 credits (TIPUM), Programme syllabus for studies starting in autumn 2020

Track, Combustion Engineering (IPUA)

Track, Machine Design (IPUB)

Track, Mechatronics (IPUC)