Programme syllabus

Master's Programme, Engineering Materials Science, 120 credits
Masterprogram, teknisk materialvetenskap
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

In addition to the objectives specified in the Swedish Higher Education Ordinance, there are also specific objectives for this programme. Graduates from the programme shall:

Knowledge and understanding

- Have extensive knowledge of both materials and processes in order to be able to develop and manufacture new materials and products
- Have such knowledge as is required to be able to work in materials-related industries within research and development as well as in production and manufacturing
- Have good insight into current research and development as well as industrial development trends

Skills and abilities

- Be proficient in utilising modern modelling and simulation methods as well as their applications
- Possess the skills in presentation, communication and teamwork needed to establish good conditions for effective work, both individually and in collaboration in groups with different compositions of individuals
- Demonstrate the skill required to participate in research and development work or to work independently in other advanced technical contexts
- Demonstrate the ability to critically, independently and creatively plan and, using adequate methods and tools, create technical solutions, processes and systems that cater to human and societal needs and thus, from an ethical and professional standpoint, contribute to the development of knowledge in society

Ability to make judgements and adopt a standpoint

- Demonstrate professional and ethical accountability in scientific, technical, ecological and societal enterprises
• Have an understanding of the fact that engineering problems, viewed from a systems perspective, are often complex, can be incompletely defined and sometimes involve conflicting conditions
• Demonstrate an understanding of the role of technology in society and people's responsibility for how it is used, including social and economic aspects as well as environmental and work environment aspects, and also in the development of new materials and processes
• Have 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 higher education credits, which corresponds to two years of full-time studies. The programme is in the second cycle and the language of instruction is English.

For the academic year 2020/2021, the programme has the following tracks that lead to a Degree of Master.
Track 1: Industrial Materials
Track 2: Materials and Process Design
Track 3: Sustainable Materials

The courses included in each track are found in appendix 1.

Choice of track is made in conjunction with the start of the programme. The choice is influenced and directed by the student's prior knowledge and profile from previous university education, and is decided in consultation with the programme director. There is no restriction on the number of places.

**Language of instruction**
Instruction is only provided in English.

**Eligibility and selection**

Eligibility requires a university education of at least 180 credits, a Bachelor of Science in Engineering or a technical Degree of Bachelor within the subject area of Materials Engineering.

Another similar technical or scientific first-cycle education and degree of at least 180 credits within, for example, Mechanical Engineering, Design and Product Realization, Engineering Chemistry and Engineering Physics may also qualify the applicant, provided that relevant courses in mathematics, chemistry, physics, thermodynamics, engineering materials and solid mechanics are included.

English skills equivalent to English, course B/6 are required.

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 is organised around courses in the applied subjects relating to engineering science and technology that are of importance to the programme's technical and scientific profile. The teaching and use of professional skills and abilities of great importance to an engineer, for example, communication, ethics, entrepreneurship, sustainable development, corporate and societal aspects, are integrated into the programme's courses.

To create a unified whole, the programme emphasises cooperation between different subjects, both in a specific year and between years. This is achieved through courses being coordinated scheduling wise, having a progression of knowledge and skills, and through the different tracks having different entry requirements, as described below;

1) Industrial Materials. This track is only intended for students with a Materials Engineering or Metallurgical background and good knowledge of metallurgical theory and principles for the production of metals, basic theory for phase transformation and thermodynamics for phase diagrams, and equilibria and transformations in metallic and ceramic materials. For students on the Materials Design and Engineering Programme, this track also leads to a Degree of Master of Science in Materials Design and Engineering, otherwise to a Degree of Master in Engineering Materials Science.

2) Materials and Process Design. This track is intended for students with another technical or scientific university education within, for example, Engineering Chemistry, Mechanical Engineering and Engineering Physics. It has a specialisation like Industrial Materials, but with an arrangement involving introductory courses in the first semester, which means that the track can be followed by students without prior in-depth materials or metallurgical knowledge.

3) Sustainable Materials. This track is intended for students with a Materials Engineering or Metallurgical background with an interest in innovation and entrepreneurship. It has a focus on substitution/replacement and process technology recycling of metallic materials in a sustainable cycle-based approach to raw materials (circular economy).

Courses

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

The programme is structured in the form of courses. Course lists are found in Appendix 1: Course list

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.

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 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 Materials Science, 120 credits (TTMVM), Programme syllabus for studies starting in autumn 2020

Track, Industrial Materials (IMTA)

Year 1

Mandatory courses (31.5 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>MH2039</td>
<td>Process Engineering</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2040</td>
<td>Applied Thermodynamics and Kinetics, Part 1</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2041</td>
<td>Applied Thermodynamics and Kinetics, Part 2</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2042</td>
<td>Simulation and Modeling Toolbox</td>
<td>6.0 hp</td>
<td>Second 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>ME2163</td>
<td>Leading People and Organizations in Different Contexts</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2000</td>
<td>Experimental Methods</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2048</td>
<td>Advanced Course in Materials Design</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2049</td>
<td>Advanced Course in Process Science</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Powder Metallurgy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MH2100  At least 30 hp conditionally elective courses must be chosen during year 1-2.  
**Casting Processing**

MH2252  At least 30 hp conditionally elective courses must be chosen during year 1-2.  
**Combustion in Industrial Processes**

MH2601  At least 30 hp conditionally elective courses must be chosen during year 1-2.

**Supplementary information**

At least 30 hp conditionally elective courses must be chosen during year 1-2.

**Year 2**

**Mandatory courses (6.0 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH2046</td>
<td>Quantum Metallurgy</td>
<td>6.0 hp</td>
<td>Second 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>KD2380</td>
<td>Corrosion and Surface Protection</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME2016</td>
<td>Project Management: Leadership and Control</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2046</td>
<td>Product Innovation</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2045</td>
<td>Energy and Materials Sustainability</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2281</td>
<td>Metal Forming</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2450</td>
<td>International Seminar in Material Processes</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Economical Process Analysis and Strategy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MH2501  At least 30 credits of the conditionally elective courses must be chosen during year 1-2.

MH2504  At least 30 credits of the conditionally elective courses must be chosen during year 1-2.

Supplementary information

Course list: Information is based upon the curriculum for academic year 2020/2021
Changes may occur

At least 30 credits conditionally elective courses must be chosen during year 1-2.

Mandatory: Degree Project in Engineering Materials Science second level 30 credits

Track, Materials design (MDNA)

Year 1

Mandatory courses (18.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH2029</td>
<td>Extractive Metallurgy</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2032</td>
<td>Mechanical Properties of Materials</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2038</td>
<td>Micro and Nano Structures in Materials</td>
<td>6.0 hp Second cycle</td>
</tr>
</tbody>
</table>

Conditionally elective courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH2000</td>
<td>Experimental Methods</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2040</td>
<td>One of the courses MH2040/MH2041 is compulsory and the other is conditionally elective</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2041</td>
<td>One of the courses MH2040/MH2041 is compulsory and the other is conditionally elective</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2042</td>
<td>At least 30 hp conditionally elective courses must be chosen during year 1-2.</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>MH2048</td>
<td>At least 30 hp conditionally elective courses must be chosen during year 1-2.</td>
<td>9.0 hp Second cycle</td>
</tr>
</tbody>
</table>
MH2049  **Advanced Course in Process Science**  
At least 30 hp must be chosen during year 1-2.  
9.0 hp  Second cycle

MH2100  **Powder Metallurgy**  
At least 30 hp must be chosen during year 1-2.  
6.0 hp  Second cycle

MH2252  **Casting Processing**  
At least 30 hp must be chosen during year 1-2.  
6.0 hp  Second cycle

MH2300  **Functional Materials**  
At least 30 hp must be chosen during year 1-2.  
6.0 hp  Second cycle

MH2601  **Combustion in Industrial Processes**  
At least 30 hp must be chosen during year 1-2.  
6.0 hp  Second cycle

**Supplementary information**

At least 30 hp conditionally elective courses must be chosen during year 1-2.

One of the courses MH2040 and MH2041 is mandatory and the other is conditionally elective.

**Year 2**

**Mandatory courses (7.5 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
</table>
| AK2036      | **Theory and Methodology of Science with Applications**  
(Natural and Technological Science) | 7.5 hp  | Second cycle       |

**Conditionally elective courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
</table>
| MH2045      | **Energy and Materials Sustainability**  
At least 30 credits of the conditionally elective courses must be chosen during year 1-2. | 6.0 hp  | Second cycle       |
| MH2046      | **Quantum Metallurgy**  
At least 30 credits of the conditionally elective courses must be chosen during year 1-2. | 6.0 hp  | Second cycle       |
| MH2281      | **Metal Forming**  
At least 30 credits of the conditionally elective courses must be chosen during year 1-2. | 6.0 hp  | Second cycle       |
| MH2450      | **International Seminar in Material Processes**  
At least 30 credits of the conditionally elective courses must be chosen during year 1-2. | 6.0 hp  | Second cycle       |
| MH2501      | **Economical Process Analysis and Strategy**  
At least 30 credits of the conditionally elective courses must be chosen during year 1-2. | 6.0 hp  | Second cycle       |
|             | **Industrial Metallurgical Processes**                       |         |                    |
MH2504  At least 30 credits of the conditionally elective courses must be 6.0 hp  Second cycle chosen during year 1-2.

Supplementary information

Course list: Information is based upon the curriculum for academic year 2020/2021, changes may occur.

Mandatory: Degree Project in Engineering Materials Science second level 30 credits.

At least 30 credits of the conditionally elective courses must be chosen during year 1-2.

**Track, Sustainable Materials (SUMA)**

**Year 1**

**Mandatory courses (13.5 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2036</td>
<td>Theory and Methodology of Science with Applications</td>
<td>7.5 hp  Second cycle</td>
</tr>
<tr>
<td>MF2032</td>
<td>Eco Design</td>
<td>6.0 hp  Second cycle</td>
</tr>
</tbody>
</table>

**Conditionally elective courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL2160</td>
<td>Environmental Management</td>
<td>7.5 hp  Second cycle</td>
</tr>
<tr>
<td>ME2719</td>
<td>Entrepreneurship and Innovation</td>
<td>7.5 hp  Second cycle</td>
</tr>
<tr>
<td>MF2022</td>
<td>Eco Design Project</td>
<td>6.0 hp  Second cycle</td>
</tr>
<tr>
<td>MH2029</td>
<td>Extractive Metallurgy</td>
<td>6.0 hp  Second cycle</td>
</tr>
<tr>
<td>MH2032</td>
<td>Mechanical Properties of Materials</td>
<td>6.0 hp  Second cycle</td>
</tr>
<tr>
<td>MH2038</td>
<td>Micro and Nano Structures in Materials</td>
<td>6.0 hp  Second cycle</td>
</tr>
</tbody>
</table>

MH2040: Advanced Course in Materials Design

MH2041: Advanced Course in Process Science

MH2048: Advanced Course in Process Science

One of the courses MH2040 and MH2041 is mandatory and the other is conditionally elective.

One of the courses MH2040 and MH2041 is mandatory and the other is conditionally elective.

One of the courses MH2048 and MH2049 is mandatory and the other is conditionally elective.

One of the courses MH2048 and MH2049 is mandatory and the other is conditionally elective.
One of the courses MH2048 and MH2049 is mandatory and the other is conditionally elective.

MH2048 Functional Materials 6.0 hp Second cycle
MH2049 Combustion in Industrial Processes 6.0 hp Second cycle

Supplementary information

One of the courses MH2040 and MH2041 is mandatory and the other is conditionally elective.

One of the courses MH2048 and MH2049 is mandatory and the other is conditionally elective.

At least 30 hp conditionally elective courses must be chosen during year 1-2.

Year 2

Mandatory courses (13.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH2045</td>
<td>Energy and Materials Sustainability</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2051</td>
<td>Circular Economy for Materials Processing</td>
<td>7.5 hp</td>
<td>Second cycle</td>
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</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>AL2181</td>
<td>Environmental System Analysis and Decision making</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>ME2016</td>
<td>Project Management: Leadership and Control</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MF2046</td>
<td>Product Innovation</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2450</td>
<td>International Seminar in Material Processes</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2501</td>
<td>Economical Process Analysis and Strategy</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2504</td>
<td>Industrial Metallurgical Processes</td>
<td>6.0 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.

At least 30 hp conditionally elective courses must be chosen during year 1-2.

Mandatory: Degree Project in Engineering Materials Science second level 30 credits
Appendix 2: Specialisations

Master's Programme, Engineering Materials Science, 120 credits (TTMVM), Programme syllabus for studies starting in autumn 2020

Track, Industrial Materials (IMTA)

Track, Materials design (MDNA)

Track, Sustainable Materials (SUMA)