Programme syllabus

Master's Programme, Nuclear Energy Engineering, 120 credits
Masterprogram, kärnenergiteknik
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

The main objective of this programme is to educate skilled engineers for the nuclear industry and research institutions in Europe and world-wide. The programme is intended for Swedish and European students, as well as students from other parts of the world.

A graduate of the master’s programme in Nuclear Energy Engineering shall

Knowledge and understanding

- demonstrate broad knowledge and understanding of technical, economic, safety and social aspects of the nuclear engineering field.
- demonstrate in-depth insight into current research and development of nuclear power systems.
- demonstrate in-depth knowledge of methods used in the nuclear engineering.

Skills and abilities

- demonstrate the ability to critically, independently and creatively identify and solve nuclear engineering problems.
- demonstrate the skills required to participate in research and development work.
- demonstrate the ability to model, simulate, predict and evaluate processes and technical properties of nuclear reactors and nuclear power plants.
- demonstrate the ability to develop and design nuclear reactors and power plants with the consideration of safety and economic aspects.
• demonstrate the ability to engage in and contribute to teamwork.

• demonstrate the ability to discuss technical solutions verbally and in writing.

**Ability to make judgements and adopt a standpoint**

• demonstrate the ability to make informed decisions regarding the design and assessment of nuclear reactors and power plants, taking into account relevant scientific, social, ethical, economic and environmental aspects.

• demonstrate awareness of and insight into possibilities and limitations of technology and science, its role in society and human responsibility for its use, including its social, economic, and environmental aspects.

• demonstrate the need for new knowledge and skills.

**Extent and content of the programme**

The master programme in Nuclear Energy Engineering at KTH is a two-year (120 university credit) educational programme on the advanced level (second cycle). The instruction language is English. The programme consists of a number of compulsory courses, and a selection of elective courses. The courses are scheduled during the first six periods of the programme, with a mix of compulsory and elective courses in each period. With the foundation of the compulsory courses, and with a suitable selection of elective courses, each student will be able to build his/her specialized expertise in a field of interest. The last two periods in the second year of the programme is dedicated to the degree project.

**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 and Programming*: must include (i) differential and integral calculus in several variables, (ii) linear algebra, (iii) numerical analysis), (iv) ordinary and partial differential equations and integral transforms, (v) and basics of programming in a higher programming language, equivalent to at least 25 ECTS credits in total.

*Physics*: must include at least 20 ECTS credits in total.
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 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 supplementary days and at least five exam days. In addition to the four regular exam periods, there are four additional re-examination periods. The academic year lasts for a duration of 40 weeks. Teaching activities may, if necessary, be scheduled outside of the academic year. The master programme in Nuclear Energy Engineering is built around a selection of compulsory courses scheduled the first six periods of the programme. The compulsory courses are intended to give the students a strong foundation in the various science and engineering fields of nuclear energy. In addition, the students are required to select a number of more specialised courses (from the list in appendix I) of elective courses. The last two periods of the second year are dedicated for the degree project.

Courses

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

Lists of compulsory courses and elective courses are included in appendix 1. The total number of compulsory courses corresponds to approximately 48 university credits. The degree project corresponds to 30 university credits. The remaining credits (to reach the full 120 credits) should consist of the elective courses, as specified in the list of appendix I. If less than five students register for an elective course, the programme director reserves the right to remove the course from that year's curriculum.

Every student is required to make an individual study plan, in agreement with the programme director of the master programme. The study plan should define which courses are selected from the course list. The study plan should be written at the start of the first period, and should then be updated once per term.

In agreement with the programme director of the master programme, a student may replace one or a few courses in the list of elective courses with other courses from the KTH curriculum, if the external course lies within the general field of the master programme.

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.

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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, in accordance to the policy of the Royal Institute of Technology and in agreement with the programme director, credits for previous studies can be received within the frame of the master programme.

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

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. The project work may begin when special admission requirements for the course are fulfilled.

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

The Degree project is graded with P/F.

Degree

In order to earn a Degree of Master of Science, 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

When the studies at KTH are completed a degree certificate can be applied for.

Application is done by the “personal menu” at www.kth.se

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

Master's Programme, Nuclear Energy Engineering, 120 credits (TNEEM), Programme syllabus for studies starting in autumn 2020

General courses

Year 1

Mandatory courses (38.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH2600</td>
<td>Nuclear Reactor Physics, Major Course</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2603</td>
<td>Radiation, Protection, Dosimetry and Detectors</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2612</td>
<td>Nuclear Power Safety</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2702</td>
<td>Nuclear Reactor Technology</td>
<td>8.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2706</td>
<td>Sustainable Energy Transformation Technologies</td>
<td>9.0 hp</td>
<td>Second cycle</td>
</tr>
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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>SH2302</td>
<td>Nuclear Physics</td>
<td>8.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2605</td>
<td>Radiation Damage in Materials</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2610</td>
<td>Leadership for Safe Nuclear Power Industry</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2611</td>
<td>Small Reactors</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2613</td>
<td>Generation IV Reactors</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2614</td>
<td>The Nuclear Fuel Cycle</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH262V</td>
<td>Elements of the Back-end of the Nuclear Fuel Cycle: Geological Storage in Precambrian Bedrock</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2701</td>
<td>Thermal-Hydraulics in Nuclear Energy Engineering</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2704</td>
<td>Monte Carlo Methods and Simulations in Nuclear Technology</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2705</td>
<td>Compact Reactor Simulator- Exercises in Reactor Kinetics and Dynamics</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2772</td>
<td>Chemistry and Physics of Nuclear Fuels</td>
<td>8.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
SH2774  Numerical Methods in Nuclear Engineering  
6.0 hp  Second cycle

Year 2

Mandatory courses (37.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2030</td>
<td>Theory and Methodology of Science (Natural and Technological Science)</td>
<td>4.5 hp</td>
<td>Second cycle</td>
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<tr>
<td>SH2007</td>
<td>Research Methodology in Physics</td>
<td>3.0 hp</td>
<td>Second cycle</td>
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<td>SH204X</td>
<td>Degree Project in Physics, Second Cycle</td>
<td>30.0 hp</td>
<td>Second cycle</td>
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</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>ED2235</td>
<td>Atomic Physics for Fusion</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EF2200</td>
<td>Plasma Physics</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MJ2411</td>
<td>Renewable Energy Technology</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2610</td>
<td>Leadership for Safe Nuclear Power Industry</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2614</td>
<td>The Nuclear Fuel Cycle</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2615</td>
<td>Neutron Transport Theory</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2701</td>
<td>Thermal-Hydraulics in Nuclear Energy Engineering</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2772</td>
<td>Chemistry and Physics of Nuclear Fuels</td>
<td>8.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SH2774</td>
<td>Numerical Methods in Nuclear Engineering</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
Appendix 2: Specialisations

Master's Programme, Nuclear Energy Engineering, 120 credits (TNEEM), Programme syllabus for studies starting in autumn 2020

This programme has no specialisations.