



# Programme syllabus

Master's Programme, Nuclear Fusion Science and Engineering  
Physics, 120 credits

Masterprogram, fusionsenergi och teknisk fysik  
*120.0 credits*

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*Valid for students admitted to the education from autumn 10 (HT - Autumn term; VT - Spring term).*

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

## Programme objectives

The aim of the European Master in Nuclear Fusion Science and Engineering Physics (FUSION-EP) programme is to provide a high-level multinational research-oriented education in fusion-related engineering physics, in close relation to the research activities of the partners, and with a well-integrated language and cultural experience. The Joint European Masters Programme offers a genuine European opportunity for Master level studies in a field which is of crucial importance to contribute to the solution of the ever more urgent and vital problem of world energy supply. The Erasmus Mundus programme is a co-operation and mobility programme in the field of higher education organised by the European Commission. It aims to enhance quality in European higher education and to promote intercultural understanding through co-operation with third countries. The programme is intended to strengthen European co-operation and international links in higher education by supporting high-quality European Masters Courses, by enabling students and visiting scholars from around the world to engage in postgraduate study at European universities, as well as by encouraging the outgoing mobility of European students and scholars towards third countries.

## Knowledge and understanding

For the master's degree, the student should:

- have thorough knowledge about the scientific foundation and common practice of the Nuclear Fusion Science
- be able to identify fusion-related engineering physics problems in various technical systems and natural phenomena, and place them in a larger context
- be able to describe technological processes using mathematical models, and to assess the applicability and limitations of the models.

## Skills and abilities

For the master's degree, the student should:

- critically select and apply analytical and numerical methods to solve problems in fusion-related engineering physics
- search and follow technical and scientific literature in fusion-related engineering and close fields
- communicate with various target groups in a professional way
- be able to plan, organize and document the work, and work together in a group.

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

For the master's degree, the student should:

- be able to analyze engineering physics problems in an independent manner acquire the information and knowledge that is necessary to establish a qualified opinion
- have an insight into possibilities and limitations of technology, its role in society, and responsibilities for its application.

## **Extent and content of the programme**

The programme is on the second level and has a duration of two years, it comprises 120 higher education credits (equivalent to 120 ECTS). The language of instruction throughout the programme is English.

The program has 3 specialisations specified below in track 1-track 3. The names of the cities and illustrate where the specializations are offered:

### **Track 1: Plasma physics**

Nancy Gent Madrid KTH Stuttgart

### **Track 2: Computational methods in physics**

Nancy Gent Madrid

### **Track 3: Instrumentation and radiation**

Madrid KTH Stuttgart

## **Eligibility and selection**

Basic eligibility to be accepted to the master's program requires a completed Bachelor's degree in engineering physics, applied physics, physics or equivalent degrees, or equivalent academic qualifications with at least 60 ECTS credits of course work in physics from an internationally recognised university. Sufficient bachelor level knowledge in classical and modern physics is mandatory. Students should have in addition, good knowledge in English, oral and written, is required. Applicants must provide proof of their proficiency in English. Specific admission requirements are:

- at least 30 ECTS credits of course work in mathematics including calculus, vector algebra, differential equations, numerical methods
- computer programming skills

Students with a Master degree in one of this field or an equivalent can request for a reduced programme (minimum 60 ECTS).

The FUSION-EP Managing Board decides on exemption of credits on the basis of proofs of exams passed. Exemption can be given up to 60 ECTS credits. This way you can get a second Masters degree in one year.

If you want to apply for exemption, make sure to include a full list of courses taken and credits received in your application. Admission and selection decisions are based on a combination of factors, including academic degrees and records, the statement of purpose, letters of recommendation, test scores, language skills and relevant work experience, if any. We also consider the appropriateness of your goals to the FUSION-EP programme. In addition, consideration may be given to how your background and life experience would contribute significantly to an educationally beneficial mix of students. Reference to: <http://www.em-master-fusion.org/>

## Implementation of the education

### Structure of the education

The education is laid out in two academic years. In view of the expertise of the partners, the programme offers three programme tracks to the student: Plasma physics (fusion-oriented); Computational methods in physics; and Instrumentation and Radiation. The programme structure is combined with a mandatory stay of the student at three universities in three countries: semesters 1&2 at University A; semester 3 at B and semester 4 (Master thesis) in C. Semesters 3&4 are in a particular track. After semester 2 a summer event is organized in which the tracks and Master thesis topics are proposed. Student mobility is an inherent part of the programme structure and philosophy.

### Courses

The programme is course-based. Lists of courses are included in [appendix 1](#).

The programme is course-based. Lists of courses are included in appendix 1. The two-year FUSION-EP programme is organised over four semesters. The total training programme has to amount up to 120 ECTS and fulfil certain requirements concerning mobility. This ensures a Master programme with a strong common standard and a maximum flexibility to accommodate for students with different interests, language knowledge and background. The first semester starts with 4 compulsory physical/technical courses complemented by a Language and Culture course intended to immerse the student in the local language and culture. The second semester counts 3 compulsory courses. The Lab project course is intended to promote the experimental and team skills of the student. Of course, different projects will be offered to the various groups. The second semester is completed by two elective courses (i.e. courses from a well-defined and restricted list). All elective courses belong to one of the programme tracks. In the second semester the student still has the freedom to choose between all three tracks. All courses count 6 ECTS credits except for the master dissertation which counts for 30 ECTS. In view of the expertise of the partners, the programme offers three programme tracks to the student: T1: Plasma physics (fusion-oriented) T2: Computational methods in physics T3: Instrumentation and radiation

The above programme structure is combined with a mandatory stay of the student at three universities in three different countries as indicated in the table below:

Semester 1 University A

Semester 2 University A

Summer event

Semester 3 University B

Semester 4 University C

## **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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## **Conditions for participation in the programme**

Term enrolment is made to the coordinator to the next receiving university at least 2 month prior to the study begins. Course selection and prerequisites are organized through the Consortium coordinator

Term enrolment is made to the coordinator to the next receiving university at least 2 month prior to the study begins. Course selection and prerequisites are organized through the Consortium coordinator in cooperation with the program coordinator. All students meet in the yearly summer event – summer school. Scholar cooperation and mobility is particularly promoted by the structural connection between the specialised track education provided in semester 3 and the master thesis in the same track in semester 4. In order to be registered for elective courses in Term 3, the student must have completed at least 45 ECTS of course work. Conditions of specialisation selection. A master thesis promoter and a co-promoter (in particular responsible to guide the student in the third semester) are assigned to each student. The summer event plays a crucial role here but this is only the yearly culmination point of contacts between the involved teachers and research groups. Description of course enrolment are organized through the receiving institution in cooperation with the program coordinator.

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## **Recognition of previous academic studies**

With reference to the above mentioned admission system. Students with a Master degree in one of this field or an equivalent can request for a reduced programme (minimum 60 ECTS).

The FUSION-EP Managing Board decides on exemption of credits on the basis of proofs of exams passed. Exemption can be given up to 60 ECTS credits. This way you can get a second Masters degree in one year.

If you want to apply for exemption, make sure to include a full list of courses taken and credits received in your application.

## **Studies abroad**

Student mobility is an inherent part of the programme structure and philosophy. Each student resides at 3 universities in 3 different countries (60 ECTS credits at university A, 30 at B and 30 at C).

## **Degree project**

Degree project corresponds to 30 credit units. In general, the obligatory courses must be completed before the degree project can be started. The degree project is normally carried out individually, and the subject is in normal cases a specialization in the field a student studies for.

## **Degree**

The agreement is based on a Dual Degree policy. Each student will receive a degree from each participating university. The Joint European Masters Programme, for the participating countries except for KTH which by Swedish law is prohibited in participating in cooperation for Joint Degree but The courses must be "integrated" to be selected under Erasmus Mundus, which means that they must foresee a study period in at least two of the three universities and that it must lead to the award of a recognised double, multiple or joint diploma. Students who have successfully completed a two-year Master's programme (120 ECTS) will be awarded a "Teknologie masterexamen", translated into English as "Degree of Master of Science (two years)".

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



# Appendix 1: Course list

Master's Programme, Nuclear Fusion Science and Engineering Physics, 120 credits (TFEPM), Programme syllabus for studies starting in autumn 2010

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## General courses

### Year 1

#### Mandatory courses (51.0 Credits)

Course code	Course name	Credits	Edu. level
<a href="#">AK1213</a>	<a href="#">Swedish Society, Culture and Industry in Historical Perspective</a>	7.5 hp	First cycle
<a href="#">ED2210</a>	<a href="#">Electromagnetic Processes in Dispersive Media</a>	6.0 hp	Second cycle
<a href="#">ED2230</a>	<a href="#">Chaos and Self-organization</a>	6.0 hp	Second cycle
<a href="#">ED2235</a>	<a href="#">Atomic Physics for Fusion</a>	6.0 hp	Second cycle
<a href="#">ED2245</a>	<a href="#">Project in Fusion Physics</a>	4.5 hp	Second cycle
<a href="#">EF2200</a>	<a href="#">Plasma Physics</a>	6.0 hp	Second cycle
<a href="#">SH2310</a>	<a href="#">Radiation Detectors and Medical Imaging Systems</a>	7.5 hp	Second cycle
<a href="#">SI2530</a>	<a href="#">Computational Physics</a>	7.5 hp	Second cycle

#### Conditionally elective courses

Course code	Course name	Credits	Edu. level
<a href="#">EF2240</a>	<a href="#">Space Physics</a>	6.0 hp	Second cycle
<a href="#">EI2410</a>	<a href="#">Field Theory for Guided Waves</a>	7.5 hp	Second cycle
<a href="#">EI2420</a>	<a href="#">Electromagnetic Wave Propagation</a>	7.5 hp	Second cycle

#### Recommended courses

Course code	Course name	Credits	Edu. level
<a href="#">DS1301</a>	<a href="#">Technical English, Intermediate Level</a>	9.0 hp	First cycle

## Supplementary information

At least two of the proposed courses should be selected Optional in both first and second year:

EF2240 Space physics

EI2410 Field Theory for Guided Waves

EI2420 Electromagnetic Wave

## Year 2

### Mandatory courses (7.5 Credits)

Course code	Course name	Credits	Edu. level
<a href="#">AK1213</a>	<a href="#">Swedish Society, Culture and Industry in Historical Perspective</a>	7.5 hp	First cycle

### Conditionally elective courses

Course code	Course name	Credits	Edu. level
<a href="#">ED2220</a>	<a href="#">Experimental Fusion Plasma Physics</a>	6.0 hp	Second cycle
<a href="#">ED2230</a>	<a href="#">Chaos and Self-organization</a>	6.0 hp	Second cycle
<a href="#">EF2230</a>	<a href="#">Experimental Techniques in Space Plasma Physics</a>	6.0 hp	Second cycle
<a href="#">EF2240</a>	<a href="#">Space Physics</a>	6.0 hp	Second cycle
<a href="#">EI2410</a>	<a href="#">Field Theory for Guided Waves</a>	7.5 hp	Second cycle
<a href="#">EI2420</a>	<a href="#">Electromagnetic Wave Propagation</a>	7.5 hp	Second cycle

## Supplementary information

At least two of the proposed courses should be selected Optional in both first and second year:

EF2240 Space physics

EI2410 Field Theory for Guided Waves

EI2420 Electromagnetic Wave



## Appendix 2: Specialisations

Master's Programme, Nuclear Fusion Science and Engineering Physics, 120 credits (TFEPM), Programme syllabus for studies starting in autumn 2010

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This programme has no specialisations.