



# Programme syllabus

[An accessible version of the syllabus can be found in the Course and programme directory.](#)

## Master's Programme, Computer Simulations for Science and Engineering 120 credits

Masterprogram, datorsimuleringar inom teknik och naturvetenskap

*Valid for students admitted to the education from autumn 18 (HT - Autumn term; VT - Spring term).*

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

### Programme objectives

This master's program (COSSE) is given in cooperation by three European universities: KTH (Sweden), Delft University of Technology, TUD (Netherlands), and Technische Universität Berlin, TUB (Germany).

The main objective of COSSE is to train students in Computational Science and Engineering (CSE) and to prepare the students for international research and development employment in academy, industry, and services sector.

A student of this two-years programme studies during the first year at one of the three universities, normally TU Berlin and continues his/her studies at another university in a different country.

The COSSE programme offers a number of specialisations within the spearhead competencies of each partner university. A student chooses his/her specialisation during the second semester and continues with courses and the degree project at the other university in this specialisation.

## Knowledge and understanding

A master's student with a degree from the COSSE program has: qualified and broad knowledge in the field of computational science and engineering including techniques for mathematical modeling, simulation and analysis.

## Skills and abilities

A master's student with a degree from the COSSE program has the ability to:

- formulate mathematical models, choose suitable methods/computer tools and construct software for high performance computers of different architectures,
- analyze different mathematical models within science and technology and work creatively, systematically and critically
- find strategies for the solution of different types of mathematical models using knowledge about the possibilities and limitations of the different methods and tools,
- communicate effectively with professionals within computational science and engineering as well as with persons working with different scientific-technological applications,
- communicate effectively with management as well as society at large using written and oral presentations,
- cooperate effectively with colleagues with different cultural backgrounds.

## Ability to make judgements and adopt a standpoint

A master's student with a degree from the COSSE program can:

- critically judge validity and limitations of results from computations on different types of mathematical models,
- identify the need for further knowledge in the field and take responsibility for keeping his/her personal knowledge up to date.

Beyond this, there are similar goals for Master's degrees defined in the higher education ordinance.

## Extent and content of the programme

The COSSE program is a two-year (120 ECTS credits) master program on the advanced level (second cycle). The instruction language is English. Some elective courses are given in Swedish.

The COSSE master's programme includes compulsory mobility for the students. The programme includes three semesters of courses studies followed by the fourth research semester spent on the Master's Thesis (30 ECTS) under the supervision of both degree-awarding universities. The joint supervision of the thesis work includes the possibility that the topic is chosen according to specializations offered by the degree-awarding universities individually.

As a general rule, students will be admitted to TU Berlin for the 1st year, for course work amounting to at least 60 ECTS as outlined in Annex 2. Upon request, students may enter KTH or TU Delft for their 1st year of studies (course work amounting to at least 60 ECTS as outlined in Annex 1), if approved by Programme Advisory Group (PAG) and endorsed by the said university. Admission for the 2nd year can in this case be either TU Berlin or KTH/TU Delft as approved by PAG and endorsed by the university being responsible for admitting the student to the 2nd year.

The second year university offers course work (at least 30 ECTS) and supervision of the Master's thesis (30 ECTS) as outlined in Annex 2. This includes a choice of a specialization at the chosen university:

- KTH: Biocomputing, bioinformatics, machine learning, computational fluid dynamics, numerical linear algebra, computational physics, numerical analysis;
- TU Delft: computational fluid dynamics, numerical linear algebra, high-performance computing, data assimilation
- TU Berlin: Optimal Control, Control Theory, Numerical Linear Algebra, Numerical Analysis

A student may choose a specialization different from the proposals above after a separate application.

## Eligibility and selection

### **General admission requirements:**

A completed Bachelor's degree, corresponding to a Swedish Bachelor's degree (180 ECTS), or equivalent academic qualifications from an internationally recognised university.

English language proficiency equivalent to (the Swedish upper secondary school) English course B /6.

### **Specific admission requirements:**

- The Bachelor degree must be from a university listed in the latest distribution of the International handbook of universities <http://www.unesco.org/iau/onlinedatabases/list.html>
- The applicant should have a solid background in mathematics, computer science and numerical analysis. The applicant should have taken the following subjects: vector calculus, ordinary differential equations, stochastics and statistics. In addition, a basic understanding of partial differential equations and basic experience of a higher programming language are required.

## Selection process

The selection is based on the collected evaluation of the following: university, contents of the degree (s), study success, personal letter, references, relevant work experience, publications (including scientific posters, etc.) and knowledge in the English language.

The evaluation scale is 1-75.

The applicant may get a lower evaluation score if a filled-in program-specific summary sheet is missing from the application documents.

# Implementation of the education

## Structure of the education

The first year of the COSSE programme is carried out at one university and is devoted to the compulsory core courses and the preparation courses for the specialization that the student chooses. The choice of specialization is done at latest after the first year when moving to the second university.

The second year is carried out at a different university than the first. The studies comprise specialization courses, elective courses and a degree project.

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. In addition to the four regular exam periods, there are four additional re-examination periods: before Christmas, in March/April, 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.

## Courses

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

For KTH courses the course goals, prerequisites, contents and examination requirements are found in the course syllabus in the Course and program directory on the KTH student web. For each study year of the program there is a course list.

The compulsory core courses correspond to ~45 ECTS credits, specialization courses ~30 ECTS credits and elective courses ~15 ECTS credits. The total sum must be at least 90 ECTS credits.

Courses are examined in many ways, for example by home assignments that are presented either using oral presentations or written reports, computer assignments, project work or traditional written exams.

## 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.

## Conditions for participation in the programme

The student is required to make a course selection for the coming semester. This must be done according to the rules of the institution where the studies will be carried out. The student is responsible for having the recommended prerequisites. In a few courses, the number of places is limited and selection, for the students who applied in time, is done according to merits such as grades and credits. The selection is done at the course-giving institution/school.

For each course, the student shall, at the start of course, register for the course according to the rules of the institution giving the course.

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.

For study year 2 a specialization has to be chosen.

## 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

Study year 1 is taken at the home university in one country and study year 2 at the host university in another country.

## Degree project

Students within the COSSE programme must complete an individual degree project which corresponds to 30 ECTS credits. The project work may begin when special admission requirements

for the course are fulfilled. The goal with the degree project is that the student should show the ability to independently carry out a degree project by using the knowledge and abilities acquired throughout the program. The degree project is carried out at the university responsible for the student's second year and is supervised by teachers from both universities.

It is the responsibility of the student to find a suitable project task.

More information about the rules for degree projects at KTH can be found at [www.kth.se](http://www.kth.se)

The degree project is graded according to the A-F grading scale.

## 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](http://www.kth.se).

In order for a COSSE student to receive double degrees from both universities, all courses in the individual study plan must be passed and the degree project must be deemed as passed by both the home and host university.

For COSSE students who have studied one of the two years at KTH, it is required that the student has fulfilled the degree ordinance and has completed courses comprising 60 ECTS credits at KTH. The degree project, carried out at the host university, must correspond to 30 ECTS credits.

COSSE students who fulfill all requirements are awarded the Degree of Master of Science (two years).

### **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](http://www.kth.se)

Appendix 1 - Course list

Appendix 2 - Programme syllabus descriptions



# Appendix 1: Course list

## Master's Programme, Computer Simulations for Science and Engineering (TDTNM)

### General courses

#### Year 1

#### Mandatory courses (45.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">SF2520</a>	Applied Numerical Methods	7.5 hp	Second cycle
<a href="#">SF2521</a>	Numerical Solutions of Differential Equations	7.5 hp	Second cycle
<a href="#">SF2524</a>	Matrix Computations for Large-scale Systems	7.5 hp	Second cycle
<a href="#">SF2561</a>	The Finite Element Method	7.5 hp	Second cycle
<a href="#">SF2568</a>	Parallel Computations for Large- Scale Problems	7.5 hp	Second cycle
<a href="#">SF2940</a>	Probability Theory	7.5 hp	Second cycle

#### Optional courses

Code	Name	Credits	Edu. level
<a href="#">DD2257</a>	Visualization	7.5 hp	Second cycle
<a href="#">SF2522</a>	Computational Methods for Stochastic Differential Equations	7.5 hp	Second cycle
<a href="#">SF2822</a>	Applied Nonlinear Optimization	7.5 hp	Second cycle

# Supplementary information

The programme is given in cooperation with KTH, TU Delft and TU Berlin.

## Year 2

### Mandatory courses (30.0 Credits)

Code	Name	Credits	Edu. level
<a href="#">SF259X</a>	Degree Project in Scientific Computing, Second Cycle	30.0 hp	Second cycle

### Conditionally elective courses

Code	Name	Credits	Edu. level
<a href="#">AK2040</a>	Theory and Methodology of Science with Applications (Computational Science)	7.5 hp	Second cycle
<a href="#">BB2280</a>	Molecular Modeling	7.5 hp	Second cycle
<a href="#">BB2300</a>	Computational Chemistry	7.5 hp	Second cycle
<a href="#">BB2441</a>	Bioinformatics	7.5 hp	Second cycle
<a href="#">DD2421</a>	Machine Learning	7.5 hp	Second cycle
<a href="#">DD2434</a>	Machine Learning, Advanced Course	7.5 hp	Second cycle
<a href="#">DD2435</a>	Mathematical Modelling of Biological Systems	9.0 hp	Second cycle
<a href="#">SF2524</a>	Matrix Computations for Large-scale Systems	7.5 hp	Second cycle
<a href="#">SF2565</a>	Program Construction in C++ for Scientific Computing	7.5 hp	Second cycle
<a href="#">SF2566</a>	Advanced Individual Course in Scientific Computing	6.0 hp	Second cycle
<a href="#">SF2567</a>	Project Course in Scientific Computing	7.5 hp	Second cycle
<a href="#">SF2832</a>	Mathematical Systems Theory	7.5 hp	Second cycle
<a href="#">SF2863</a>	Systems Engineering	7.5 hp	Second cycle
<a href="#">SF2935</a>	Modern Methods of Statistical Learning	7.5 hp	Second cycle
<a href="#">SF2942</a>	Portfolio Theory and Risk Management	7.5 hp	Second cycle
<a href="#">SF2956</a>	Topological Data Analysis	7.5 hp	Second cycle
<a href="#">SF2980</a>	Risk Management	7.5 hp	Second cycle
<a href="#">SK2530</a>	Introduction to Biomedicine	6.0 hp	Second cycle



## Supplementary information

Conditionally elective course shall be chosen after agreement with the director of the programme. In the second study year, 4 courses out of the conditionally elective courses must be selected.



# Appendix 2: Specialisations

## Master's Programme, Computer Simulations for Science and Engineering (TDTNM)

This programme has no specialisations.