



Programme syllabus

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

Masterprogram, datorsimuleringar inom teknik och naturvetenskap
120.0 credits

Valid for students admitted to the education from autumn 15 (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 an Erasmus Mundus master's program given in cooperation by four European universities (partner universities): KTH, Delft University of Technology (TUD), Technische Universität Berlin (TUB) and Friedrich-Alexander Universität in Erlangen/Nürnberg (FAU).

The main objective of COSSE is to train students in computational science and engineering.

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 programme consists of a block of compulsory core courses (~45 ECTS credits) which can be taken at any of the four partner universities. This block is followed by courses within one of the following eight specializations:

KTH

- biocomputing
- computational material science

TUB

- computational control theory
- computational optimization

TUD

- computational fluid dynamics
- numerical linear algebra

FAU

- scientific visualization and image processing
- high performance computing

Core courses and specialization courses comprise ~75 ECTS credits. With optional courses comprising ~15 ECTS credits, the total sum for the courses is at least 90 ECTS credits. The concluding degree project within the chosen specialization comprises 30 ECTS credits.

Eligibility and selection

General admission requirements: A well executed Bachelor's degree (BSc, BEng or corresponding) comprising 180 ECTS credits from a university approved by the Swedish authorities or accredited of an authorized organisation. Stable knowledge in written and spoken English. The applicant must present proof of knowledge in English.

See KTH general admission requirements for Master's programmes:

<http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/antagning/1.27192>

Specific admission requirements: Prerequisites for the Master's programme in computer simulation for science and engineering:

- 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.
- The B.Sc. Cumulative Grade Point Average (CGPA) must be at least 75% of the scale maximum.
- Knowledge in the English language should be documented in the form of achieved credits in one of the named internationally known language tests

Detailed credits requirements for the language test, and requirements about when and how the documentation should be sent in can be found at <http://www.kth.se/studies/programmes/master/em/cosse/application/admissionrequirements>

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.

Implementation of the education

Structure of the education

The duration of the academic year at KTH is 40 weeks. The academic year at KTH is divided into four periods. Each period is followed by an exam period. Apart from these exam periods, there are three re-exam periods.

For details about the structure of the academic year see http://www.kth.se/student/schema/1.1007?l=en_UK

The first year of the COSSE programme is carried out at the home 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 during a common, compulsory, workshop which is held in the beginning of the second semester. Coordinated with the workshop, an individual study plan is constructed for each COSSE student.

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

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.

After each course a student evaluation is performed and then analyzed by the course leader in the course analysis document, which is normally published on the web, see the KTH regulations for course analysis: <http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/kursanalys>

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.

At the start of each semester the student is required to make a study enrollment for the next semester.

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.

Choice of specialization is done during a workshop at the beginning of the second semester. The division of the students into the different specializations is based, foremost, on the students' preferences, and secondly on the results of the previous studies with the constraint of an even distribution of the students at each of the four universities.

Promotion to second year

In order to be promoted to the second study year, the student must have completed at least 45 ECTS credits from study year one and have chosen a specialization for study year 2.

Students who do not fulfill these requirements must – in cooperation with the CSC program office, make an individual course plan for continued studies.

Recognition of previous academic studies

Credits for studies at another university can be transferred. An application form can be found on the KTH Student pages.

The application form is submitted to the CSC Program Office.

For in-depth information about the KTH policy for credit transfer, see <http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/prestationer/1.27200>

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. In order to start the degree project, at least 60 ECTS credits of the total number of course credits must be completed, where 10 ECTS credits are from the student's specialization. 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 host university and is supervised by teachers from both the home university and the host university.

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 http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examensarbete/1.27212?l=en_UK

Degree

The student can, after completing the program, apply for the Degree of Master of Science (Two Years).

Guidelines for how the application is done can be found on KTH student web.

Conditions for the Degree of Master of Science (Two Years)

In order for a COSSE student to receive double degrees from both the home and host university, 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). The students must apply in order to receive the degree and show proof of his/her Bachelor degree (BSc, BEng or corresponding).

The application form for the degree is found at the personal menu at www.kth.se.

See also the KTH regulations at http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227?l=en_UK

[Appendix 1 - Course list](#)

[Appendix 2 - Programme syllabus descriptions](#)



Appendix 1: Course list

Master's Programme, Computer Simulations for Science and Engineering, 120 credits (TDTNM), Programme syllabus for studies starting in autumn 2015

General courses

Year 1

Mandatory courses (37.5 Credits)

Course code	Course name	Credits	Edu. level
SF2520	Applied Numerical Methods	7.5 hp	Second cycle
SF2521	Numerical Solutions of Differential Equations	7.5 hp	Second cycle
SF2561	The Finite Element Method	7.5 hp	Second cycle
SF2568	Parallel Computations for Large- Scale Problems	7.5 hp	Second cycle
SF2940	Probability Theory	7.5 hp	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
BB2300	Computational Chemistry	7.5 hp	Second cycle
DA2205	Introduction to the Philosophy of Science and Research Methodology	7.5 hp	Second cycle
DD2325	Applied Programming and Computer Science	7.5 hp	Second cycle
DD2404	Applied Bioinformatics	7.5 hp	Second cycle
SF2566	Advanced Individual Course in Scientific Computing	6.0 hp	Second cycle
SG2212	Computational Fluid Dynamics	7.5 hp	Second cycle

Conditionally elective courses

Course code	Course name	Credits	Edu. level
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DD2257	Visualization Track 5,8	7.5 hp	Second cycle
DD2365	Advanced Computation in Fluid Mechanics Track 5, 7	7.5 hp	Second cycle
SF2522	Computational Methods for Stochastic Differential Equations Track 3,4	7.5 hp	Second cycle
SF2524	Matrix Computations for Large-scale Systems Track 6, 7	7.5 hp	Second cycle
SF2567	Project Course in Scientific Computing Track 6,8	7.5 hp	Second cycle
SF2822	Applied Nonlinear Optimization Track 3,4	7.5 hp	Second cycle

Supplementary information

The programme is given in cooperation with KTH, TU Delft, TU Berlin and University of Erlangen. Each university is responsible for two tracks that are given year 2:

- 1 Biocomputing KTH
- 2 Computational Material Science KTH
- 3 Computational Control Theory TU, Berlin
- 4 Computational Optimization TU, Berlin
- 5 Computational Fluid Dynamics TU, Delft
- 6 Numerical Linear Algebra TU, Delft
- 7 High Performance Computing Univ. of Erlangen
- 8 Scientific Visualization and Medical Image Processing Univ. of Erlangen

A new course: DD2365 Advanced Computation in Fluid Mechanics will be given for the first time Spring 2015. It will be conditionally elective for track 5 and 7.

Year 2

Mandatory courses (45.0 Credits)

Course code	Course name	Credits	Edu. level
DD2435	Mathematical Modelling of Biological Systems Track 1	9.0 hp	Second cycle
SF259X	Degree Project in Scientific Computing, Second Cycle	30.0 hp	Second cycle
SK2530	Introduction to Biomedicine Track 1	6.0 hp	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
BB2300	Computational Chemistry	7.5 hp	Second cycle

DA2205 Introduction to the Philosophy of Science and Research Methodology	7.5 hp	Second cycle
DD2404 Applied Bioinformatics	7.5 hp	Second cycle

Supplementary information

Track 1 = Biocomputing

Track 2 = Computational Material Science



Appendix 2: Specialisations

Master's Programme, Computer Simulations for Science and Engineering, 120 credits (TDTNM), Programme syllabus for studies starting in autumn 2015

This programme has no specialisations.