Eidgenössische Technische Hochschule Zürich
Ecole polytechnique fédérale de Zurich
Politecnico federale di Zurigo

Departments of Mathematics and Physics (D-MATH/D-PHYS)

Guidelines

to the Master Program in

Computational Science and Engineering

2010 Edition[1]

Contents *Page*

1. Computational Science and Engineering (CSE) 3
2. General study information 4
2.1 Admission 4
2.2 Enrolment 4
2.3 Course syllabus 4
2.4 Credit system 5
2.5 Earning credit points 5
2.6 Visiting semesters at other universities 5
2.7 Graduation 6
2.8 Maximum duration of studies 6
2.9 Breaking off studies 6
2.10 Performance control 7
2.11 Ruling bodies 8
3. Overview of the CSE Master Program 9
4. The CSE Master Program 11
4.1 Admission to the CSE Master Program 11
4.2 Core courses and compensatory courses 12

[1] These guidelines apply for students enrolling in the CSE Master Program from the 2009 autumn semester.

4.3 Fields of specialisation 13
4.4 Elective courses 17
4.5 Case studies 17
4.6 Term paper 18
4.7 GESS 18
4.8 Master thesis 18
4.9 Performance control 19
5. The CSE Master degree 20
5.1 Credit points 20
5.2 Graduation 20
5.3 Grades and grade point average 21
6. Doctoral studies 22
7. Relevant documents and addresses 24

1. Computational Science and Engineering (CSE)

Solving **interdisciplinary science** and **engineering** problems using **computers**

The Computational Science and Engineering curriculum provides future-oriented education in Mathematics, Computer Science and at least two fields of application from the natural and engineering sciences. CSE graduates will be able to understand a problem from the scientific and technological point of view and have the requisite skills to perform a computer-based analysis. They will be capable of working and thinking in an interdisciplinary way.

Profile and educational objective

Computational science and engineering means mathematical modelling, numerical solution techniques and the use of computers to analyse and solve scientific and technological problems. Besides studies in the fields of application from science and engineering, students will learn how to use the most important mathematical methods and computer tools. CSE is different from both computer science and the traditional science and engineering. It represents a third scientific way in addition to theory and experiment. In brief, computational science and engineering is interdisciplinary, application oriented, focused on problem solving, and based on computer simulation.

CSE graduates are able to communicate with specialists from the areas of mathematics, physics, chemistry, biology, engineering and computer science and work together with them in finding solutions to complex practical problems.

The interdisciplinary education the CSE curriculum provides in mathematics, computer science and application is an ideal basis for a career in industry and business.

2. General study information

2.1 Admission

Admission to all study programs at ETH is processed through the *Rektorat* (Rectorate). It provides students with all the relevant information, in particular on transferring from another university or switching from another study program, on the recognition of student credits already acquired, and on any specific admission requirements.

The CSE Master Program in the departments of Mathematics an Physics (D-MATH/D-PHYS) is scheduled to last 1½ years.[2] CSE Bachelor students can enrol directly in the CSE Master program provided they need to acquire only a small number of credit (ECTS) points. Students from outside ETH must apply for enrolment at the ETH Zürich Rectorate. The application may be made before the required academic degree has actually been earned. The *Zulassungsausschuss RW (*CSE Admissions Committee) assesses the candidates' knowledge level in the relevant subjects and their suitability for the Master program. It then formulates a recommendation for admission or non-admission addressed to the *Studienvorsteher* (Head of Student Studies D-MATH/D-PHYS), together with information on credit points acquired and those still to be earned. Candidates with a university degree having to acquire 30 or more credit points cannot be admitted to the CSE Master program. They may apply for admission to the CSE Bachelor program.

2.2 Enrolment

The Master program requires regular enrolment for each coming semester and for the courses to be attended. Place of enrolment is the *Rektorat* (Rectorate):

https://www.mystudies.ethz.ch

2.3 Course syllabus

The courses offered are published on the Internet each semester:

www.vvz.ethz.ch

The *Vorlesungsverzeichnis* (course syllabus) provides basic information on the individual courses:

Curriculum >	Number >
Semester >	Room >
Type >	Time >
Lecturer >	Number of hours per week >
Title >	Language >
Content >	Objective >
Credit points >	Performance control (exam?)

[2] Up to a maximum of 2½ years if special admission requirements need to be fulfilled

In case of exam:	Conditions of admission >
Date (session?) >	Weight of grade >
Mode (written/oral?) >	Duration >
Exam aids permitted >	Examiner (if not lecturer)

2.4 Credit system

The study program uses a credit system which corresponds to the *European Credit Transfer System (ECTS)*. The *credit points (KP)* awarded for each defined study achievement reflect the average real amount of work required to attain this achievement. One credit point is roughly equivalent to 30 hours of work. The entire amount of work required per semester for full-time studies is equivalent to 30 KP on average. The CSE Master Program is designed to cover 3 semesters (2 semesters plus a subsequent Master thesis) during which students need to acquire 90 credit points in total.

2.5 Earning credit points

The credit points assigned to a course are awarded either in full or not at all. They are awarded if the performance control defined for the course in question has been passed. If grades are awarded for the performance control, the grade achieved must be at least 4.0.

All courses apart from exam blocks are evaluated independently, and a student is required to repeat only those performance controls or courses for which he or she did not pass the performance control the first time.

Courses which are combined to form *exam blocks*, on the other hand, are evaluated as a single activity. The exams associated with an exam block must all be taken during the same exam session. An exam block is considered to have been passed in its entirety if the weighted average grade for the block is at least 4.0. In this case the student is awarded the credit points for all the courses in that block, even if grades for individual courses are below 4.0. However, if the student does not pass the exam block, all exams in that block must be retaken. It is up to the student to decide whether or not to retake the courses.

Administration of credit points is carried out by the Student Administration Office D-MATH/D-PHYS.

2.6 Visiting semesters at other universities

In the Master Program any number of KP can be earned at another university. However, only a maximum of 30 such KP can be used for earning the Master degree; any remaining KP will be listed on a separate sheet attached to the graduation certificate at the student's request.

Before they begin visiting semesters at other universities, students must draw up a written study plan in collaboration with the *Fachberater RW* (Advisor of Studies CSE). This plan shows the study achievements that the student expects to attain at the host university. The study plan must be approved by the Head of Student Studies D-MATH/D-PHYS.

Further information about visiting semesters (administrative matters, stipends, etc.) can be obtained from the Advisor of Studies CSE and the *Mobilitätsstelle des Rektorats* (Student Exchange Office of the Rectorate).

2.7 Graduation

Once the student has acquired the necessary number of credit points, an application can be made for a Master degree to be awarded. The application must be submitted to the Student Administration Office D-MATH/D-PHYS and must list all the study performance that needs to be included in the graduation certificate (*Schlusszeugnis*). The sum of KP in each category must be at least equal to the required minimum number. The graduation certificate lists study performance and the associated grades, other evaluations of performance, and the grade average calculated from the grades achieved (without GESS).

Once the Master degree has been awarded, graduates receive a degree certificate and a diploma supplement.

2.8 Maximum duration of studies

Students must apply for a degree to be awarded within three years of starting the Master Program. If a student is admitted to the Master Program CSE on the condition that additional KP are earned, this entitles the student to extend the maximum duration of studies by six months if an additional 21–30 KP need to be earned and by a year if an additional 31–60 KP are required. A requirement to earn fewer than 21 additional KP does not entitle the student to extend the maximum duration of studies.

The Rector may extend the maximum duration on written request if there are sufficient reasons.

2.9 Breaking off studies

Students who will not be able to earn the necessary number of credit points because they have failed performance controls twice or because they will be unable to complete the curriculum within the maximum permitted duration will be excluded from the curriculum. Those who break off their studies or are excluded from the curriculum will receive a certificate showing all the achievements during their studies which were assessed.

2.10 Performance control

The performance control stipulated for each course is shown in the course syllabus (www.vvz.ethz.ch) (see Section 2.3). The performance control for most courses is a written or oral exam. The form of performance control for a course is determined by the department offering the course.

Grades

Exams and the Master thesis are always graded, other performance controls may be evaluated as passed/not passed. The best grade is 6.0, the poorest 1.0; half- and quarter-grades within this range may be awarded.

Exams

Exams are generally held during the *exam sessions*. There are two exam sessions each year, with exam dates determined for all ETH curricula. Exams held during the sessions are coordinated centrally by the Rectorate. An *interim certificate* is issued after each exam session, showing the grades achieved since the last interim certificate was issued. The details of the exam (written or oral, duration of exam) are determined by the Teachers Conference D-MATH/D-PHYS (*Unterrichtskonferenz*) and are shown in the examination plan.

Oral exams are held either by two examiners or by one examiner and an assessor.

- The exam for a course which is held regularly is always based on the most recently held course and is set by the lecturers who taught it. If students put off taking a certain exam, there is a risk that the lecturer will change, thus changing the course content. Students are not entitled to insist on a specific examiner for either a first or a repeat exam. For these reasons it is recommended that students should undergo performance controls at the earliest opportunity whenever possible.

Admission conditions

Admission to an exam may be made conditional on the exercises allocated during the course in question. Conditions of this kind are announced at the start of the semester and are also listed in the course syllabus (see Section 2.3) (www.vvz.ethz.ch).

Registration and withdrawal

The Rectorate announces the place and deadline for registration for exams to be held in an exam session. Registration is carried out electronically around the middle of the preceding semester.

Students register directly with the lecturers concerned for exams scheduled outside the exam sessions and for other performance controls.

Interruption, absence, late submission

An exam session may only be interrupted for important reasons such as illness or an accident. A student who interrupts an exam session must inform the registering office immediately and submit the necessary doctor's certificate.

Repetition of performance controls

A performance control which has been passed cannot be repeated. A performance control which has been failed can be repeated only once. If the student fails twice, the performance control is considered to have been failed definitively. Students who fail definitively in mandatory courses will be excluded from the curriculum. Students who fail definitively in a non-mandatory course must choose another such course.

2.11 Ruling bodies

Decisions affecting the D-MATH/D-PHYS curricula are the responsibility of the Rectorate, the Students/Teachers Commission D-MATH/D-PHYS (*Unterrichtskommission)*, the Teachers Conference D-MATH/D-PHYS (*Unterrichtskonferenz*), the Head of Student Studies D-MATH/D-PHYS (*Studienvorsteher*).

It is the CSE Committee (*Ausschuss RW*), the Director of Studies CSE (*Studiendelegierter RW*) and the Advisor of Studies CSE (*Fachberater RW*) who are primarily responsible specifically for the CSE programs; the Student Administration Office D-MATH/D-PHYS is responsible for administrative matters. (See Chapter 7 for addresses).

- The students elect representatives to the Students/Teachers Commission and other ruling bodies; these representatives participate and have voting rights.

3. Overview of the CSE Master Program

The CSE Master Program offered by D-MATH/D-PHYS requires 1½ years of study[3] (2 semesters followed by five months to write a Master thesis). The 90 credit points[3] required for a Master degree are earned in mandatory core courses, in elective courses and fields of specialisation chosen by the students, as well as in a term paper and a Master thesis.

	The Master Program in CSE		
Study period	1st/2nd semester		Master thesis
Credit points	60		30
(minimum number)	Core courses	12	5 months
	Fields of specialisation	18	
	Elective courses	6	
	Case studies	6	
	Term paper	8	

Master degree:	Master of Science ETH in Computational Science and Engineering Abbreviated title: **MSc ETH CSE**
(German:	Master of Science ETH in Rechnergestützten Wissenschaften Abbreviated title: **MSc ETH RW**)

The **core courses** are courses which are of central importance in computational science and engineering. They equip students with computational mathematical methods and advanced knowledge of computer science.

List of core courses:

- Visual Computing
- Computational Statistics

The **fields of specialisation** provide deeper understanding of the areas of application in computational science and engineering.

List of fields of specialisation:

- Astrophysics
- Physics of the Atmosphere
- Chemistry and Biology
- Fluid Dynamics
- Control Theory
- Robotics
- Theoretical Physics
- Financial Engineering

[3] Up to a maximum of 2½ years if an additional 60 KP (maximum) need to be earned subject to specified admission requirements

- Electromagnetics
- Geophysics
- Systems Biology

The **elective courses** provide students with more extensive and more in-depth knowledge of theory and methods.

In the **case studies** seminar internal ETH and external speakers present examples from their own fields of application – from modelling to computer-based problem solving. Students have to give a short presentation on some scientific paper.

The **term paper** enables students to deepen their knowledge of a certain field, to come into closer contact with applications, and to tackle the problems arising from such applications using computers. In addition, the purpose of term papers is to teach students to collaborate with an existing scientific group. The subject for the term paper is usually taken from a core course or from a field of specialisation.

The **Master thesis** is the conclusion of the program. Its purpose is to allow students to demonstrate their ability to carry out scientific work in an independent and structured manner. The subject for the Master thesis is usually taken from a core course or from a field of specialisation.

The CSE Master Program follows on from the CSE Bachelor Program offered by ETH. Its objective is to make new, computer-based career profiles accessible to students. The interdisciplinary training in mathematics, computer science and applications is excellent preparation for a career in business and industry.

4. The CSE Master Program

4.1 Admission to the CSE Master Program

Admission requirements

Individuals requesting admission to the CSE Master Program will generally have to meet the following requirements:

a. They have a CSE Bachelor degree from D-MATH/D-PHYS.

b. They have a Bachelor degree comprising at least 180 credit points (ECTS) from a university or from a Swiss university of applied science, or a university qualification of at least equivalent value in a subject which qualifies them for admission to the CSE Master Program. The subject background required (*Requirement Profile*) is detailed in the appendix to the Study Regulations 2005 for the CSE Master Program. Moreover, they must demonstrate that their knowledge of the teaching language – English – is adequate.

The Rector decides on exceptions based on the recommendation of the Head of Student Studies D-MATH/D-PHYS.

Admission procedure

CSE Bachelor students from D-MATH/D-PHYS can enrol directly in the CSE Master Program provided they need to acquire no more than 30 credit points to gain a Bachelor degree. The dates and deadlines for enrolment apply as issued by ETH. Admission is conditional on the student gaining the Bachelor degree. The right of admission lapses if the student does not gain the Bachelor degree or cannot gain it because he or she has failed performance controls or has exceeded the maximum permitted study duration for the Bachelor Program. The Rector decides on exceptions based on the recommendation of the Head of Student Studies D-MATH/D-PHYS.

All other candidates must apply for admission to the CSE Master Program at the ETH Zürich Rectorate. The application may be registered before the required academic degree has been earned. The procedure for this is determined by the Rector. The CSE Admissions Committee (*Zulassungsauschuss RW*) assesses the candidates' knowledge level in the relevant subjects and their suitability for the Master Program. It then formulates a recommendation for admission or non-admission which is submitted to the Head of Student Studies D-MATH/D-PHYS, together with information on credit points acquired and those still to be earned. The Rector decides, based on the recommendation of the Head of Student Studies D-MATH/D-PHYS, on admission or non-admission, as well as on the number of credit points acknowledged and those still to be earned. The student may not join the Master Program until the required university degree or certificates of achievement have been acquired.

Important *links* for students from outside ETH:

Master studies at ETH Zurich:
www.ethz.ch/prospectives/master

Admissions office:
www.rektorat.ethz.ch/about/student_admin/admissions_office

Refusal of admission

Candidates with a university degree will not be admitted to the CSE Master Program if they still need to complete studies accounting for more than 30 credit points to qualify for admission. These candidates may apply for admission to the CSE Bachelor Program. The details of the admission procedure are regulated in the Rules on Admission to Studies at ETH (*Zulassungsverordnung ETHZ*).

4.2 Core courses and compensatory courses

The *core courses* are courses[4] which are of central importance in computational science and engineering. They equip students with computational mathematical methods and advanced knowledge of computer science.

The core courses:

Course	*SWS*	*Sem.*	*D-*	*KP*
Visual Computing	4V 3U	HS	INFK/RW	8
Computational Statistics	3V 2U	FS	MATH/RW	10

Two core courses must be attended and examinations must be taken in both.

If a student is unable to earn the required number of KP because he or she has twice failed an exam in a core course, the missing KP can be acquired in *compensatory courses*. Of the 12 KP that must at least be acquired in the category "Core courses and compensatory courses", at least 5 KP must come from the subcategory "Core courses".

The compensatory courses:

Course	*SWS*	*Sem.*	*D-*	*KP*
Mathematical Physics I	3V 2U	HS	MATH/PHYS	6
Theory of Functions	3V 2U	HS	MATH/PHYS	6

[4] *Key to the tables in these guidelines:*

SWS	Number of hours per week during semesters
Sem.	Semester in which the course is held (HS: autumn semester; FS: spring semester)
D-	Main department for which the course is offered
KP	Number of credit points
V	Lectures (number of hours)
U	Exercise classes (number of hours)
G	Lectures and/or exercise classes (number of hours)
O	Mandatory course

- The information in these tables may no longer be up to date. Students are advised to refer to the syllabus (www.vvz.ethz.ch) published on the Internet.

4.3 Fields of specialisation

The fields of specialisation provide in-depth knowledge of applications in computational science and engineering.

Five courses must be attended in the category "Fields of specialisation", one of them a seminar. In the seminar a semester project must be completed. In the other courses exams have to be taken.

Students who did not go through the D-MATH/D-PHYS CSE Bachelor Program have to take the five courses in the same field of specialisation *("major specialisation")*[5].

Students who have completed the D-MATH/D-PHYS CSE Bachelor Program can choose between two options:

a. The five courses, including the seminar, belong to the same field of specialisation – one which the student did not study in the CSE Bachelor Program *("major specialisation")*[5].

b. Three courses, including the seminar, come from the field of specialisation that the student studied in the CSE Bachelor Program *("major specialisation")*[5]; two courses come from a different field of specialisation *("minor specialisation")*[5].

- Students on the CSE Bachelor Program must select a "minor specialisation"[5] (two courses). This can be expanded into a "major specialisation"[5] (four courses and one seminar) on the CSE Master Program; alternatively, the student may choose a new "major specialisation" on the CSE Master Program.

- The following applies to students who have already attended courses in the fields of specialisation and sat the associated exams as part of the CSE Bachelor Program:
  - Students who have failed an exam once can only re-sit the exam for the corresponding course once on the CSE Master Program.
  - Students who have failed an exam twice cannot take the corresponding course on the CSE Master Program.
  - Students who have passed an exam but have not put the KP earned in the process towards their Bachelor degree can use these KP to acquire the Master degree by having them credited to the category "Fields of specialisation" or the category "Elective courses".

[5] *All* fields of specialisation are eligible for a “minor specialisation” but only those in the list below labelled as major are eligible for a “major specialisation”.

- In justified exceptional cases, the Director of Studies CSE may, at the student's request, approve attendance of courses other than those available in the fields of specialisation.

The fields of specialisation

a.	Astrophysics	(minor)
b.	Physics of the Atmosphere	(major)
c.	Chemistry and Biology	(major)
d.	Fluid Dynamics	(major)
e	Control Theory	(minor)
f.	Robotics	(major)
g.	Theoretical Physics	(major)
h.	Financial Engineering	(major)
i.	Electromagnetics	(major)
k.	Geophysics	(minor)
l.	Systems Biology	(minor)

Courses in the fields of specialisation

a. Astrophysics (*Contact:* Mayer L., Astrophysics, Zurich University)

Course	*SWS*	*Sem.*	*D-*	*KP*
Astrophysical Dynamics	4V 1U	HS	UNIZ	10
Theoretical Astrophysics and Cosmology	3V 2U	FS	UNIZ	10

b. Physics of the Atmosphere (*Contact:* Schär Ch., D-UWIS)

Course	*SWS*	*Sem.*	*D-*	*KP*
Atmosphäre	2V	HS	UWIS	3
Numerical -Modelling of Weather and Climate	3G	FS	UWIS	4
Boundary Layer Meteorology and Air Pollution Modelling	2G	HS	UWIS	2
Dynamics of Large-Scale Atmospheric Flow	2V 1U	HS	UWIS	4
Numerical Models in Glaciology	3G	FS	UWIS	4
Seminar in Physics of the Atmosphere for CSE		HS/FS	RW	4

c. Chemistry and Biology (*Contact:* van Gunsteren W., D-CHAB)

Course	*SWS*	*Sem.*	*D-*	*KP*
Computer Simulation in Chemistry, Biology and Physics	3G	HS	CHAB	7
Quantum Chemistry	3G	FS	CHAB	6
Computational Biology	3V 2U	HS	INFK	6

Computer Applications: Finite Elements in Solids and Structures	2V 2U	FS	MATL	4	
Advanced Quantum Chemistry	3G	HS	CHAB	7	
Seminar in Chemistry and Biology for CSE		HS/FS	RW	4	

d. Fluid Dynamics (*Contact:* Kleiser L., D-MAVT)

Course	*SWS*	*Sem.*	*D-*	*KP*	*
Fluid Dynamics II	2V 1U	HS	MAVT	3	O
Advanced CFD Methods	2V 1U	FS	MAVT	4	O
Berechnungsmethoden der Energie- und Verfahrenstechnik	2V 2U	FS	MAVT	4	
FSQuantitative Flow Visualisation	2V 1U	HS	MAVT	4	
Turbulent Flows	2V 1U	HS	MAVT	4	
Turbulence Modeling	2V 1U	FS	MAVT	4	
Simulations Using Particles	2V 1U	FS	INFK4FSSeminar in Fluid Dynamics for CSE		
		HS/FS	RW	4	

e. Control Theory (*Contact:* Morari M., D-ITET)

Course	*SWS*	*Sem.*	*D-*	*KP*
Regelsysteme	4G	HS	ITET	6
Regelsysteme II (Control Systems II)	4G	FS	ITET	6

f. Robotics (*Contact:* Nelson B., D-MAVT)

Course	*SWS*	*Sem.*	*D-*	*KP*	*
Theory of Robotics and Mechatronics	3G	HS	MAVT	4	O
Autonomous Mobile Robots	2V 1U	FS	MAVT	4	O
Information Processing for Robotics	3G	HS	MAVT	4	
Machine Learning	3V 2U	HS	INFK	6	
Image Analysis and Computer Vision I	4G	HS	ITET	6	
Computational Photography and Video	2V 1U	FS	INFK	5	
Dynamic Programming and Optimal Control	3G	HS	MAVT	4	
Introduction to Recursive Filtering and Estimation	2V 1U	FS	MAVT	4	
Seminar in Robotics for CSE		HS/FS	RW	4	

g. Theoretical Physics (*Contact:* Troyer M., D-PHYS)

Course	*SWS*	*Sem.*	*D-*	*KP*
Introduction to Computational Physics	2V 2U	HS	PHYS/RW	8
Computational Statistical Physics	2V 2U	FS	PHYS/RW	8
Computational Quantum Physics	2V 2U	FS	PHYS/RW	8
Computational Polymer Physics	2V 2U	FS	MATL/RW	4
Seminar in Theoretical Physics for CSE		HS/FS	RW	4

h. Financial Engineering (*Contact:* Schwab C., D-MATH)

Course	*SWS*	*Sem.*	*D-*	*KP*
Mathematical Foundations for Finance	3V 1U	HS	MATH/RW	4
Computational Methods for Quantitative Finance I - Monte Carlo and Sampling Methods	3 V 1U	HS	MATH/RW	6
Computational Methods for Quantitative Finance - PDE methods	3V 1U	FS	MATH/RW	6
Continuous Time Quantitative Finance	3V	FS	MATH/RW	4.5
Advanced Financial Engineering	3G	FS	UNIZ	4.5
Seminar in Financial Engineering for CSE		HS/FS	RW	4

i. Electromagnetics (*Contact:* Hafner Ch., D-ITET)

Course	*SWS*	*Sem.*	*D-*	*KP*
Felder und Komponenten I	2V 2U	HS	ITET	4
E in numerische Feldberechnungsverfahren	4G	FS	ITET	6
Physical Modelling and Simulation	4G	HS	ITET	5
Antennas & Propagation	4G	FS	ITET	6
Seminar in Electromagnetics for CSE		HS/FS	RW	4

k. Geophysics *(Contact:* Tackley P., D-ERDW)

Course	*SWS*	*Sem.*	*D-*	*KP*
1) Continuum Mechanics & Numerical Modelling II	2V 2G	HS	ERDW	6
2) Dynamics of the Mantle and Lithosphere	2G	FS	ERDW	3
3) Modelling for Applied Geophysics & Inverse Theory for Applied Geophysics	2G 2V	FS	ERDW	6
4) Seismic Tomography	4G	HS	ERDW	3
5) Seismology of the Sperical Earth	2G	FS	ERDW	3

- Recommended combinations: 1) and 2); 4) and 5); 1) and 3); 4) and 3) .

l. Systems Biology *(Contact:* Stelling J., D-BSSE)

Course	*SWS*	*Sem.*	*D-*	*KP*
Computational Systems Biology	2V 1U	HS	BSSE/RW	4
Multiscale Modeling and Computation	2V 2U	HS	INFK/RW	6
Statistical Models in Computational Biology	2V 1U	FS	BSSE/RW	5
Mathematical Modelling in Developmental Biology	3G	FS	BSSE/RW	5

- The information in these tables may no longer be up to date. Students are advised to refer to the syllabus (*www.vvz.ethz.ch*) published on the Internet.

- Fields of specialisation without a seminar may only be selected as a "minor specialisation".

4.4 Elective courses

Elective courses provide students with more extensive and more in-depth knowledge of theory and methods.

Students must take at least two elective courses and sit exams in these subjects.

The courses from which students may select are listed in the published course syllabus (*www.vvz.ethz.ch*). Courses in the fields of specialisation may also be chosen as elective courses provided that they are not already part of the student's chosen fields of specialisation. Courses from the category "Compensatory courses" cannot be counted as elective courses. The Director of Studies CSE may approve additional elective courses on request.

- The following applies to students who have already sat exams in elective courses as part of the CSE Bachelor Program:
    - Students who have failed an exam once can only re-sit the exam for the corresponding course once on the CSE Master Program.
    - Students who have failed an exam twice cannot attend the corresponding course on the CSE Master Program.
    - Students who have passed an exam but have not put the KP earned in the process towards their Bachelor degree can use these KP to acquire the Master degree.

4.5 Case studies

In the case studies seminar internal ETH and external speakers present examples from their own fields of application – from modelling to computer-based problem solving. Students have to give a short presentation on some scientific paper. One course per semester is offered.

The case studies seminar is assessed as passed/not passed and is equivalent to 3 KP.

Students must attend the case studies seminar twice. The Head of Student Studies D-MATH/D-PHYS may approve exceptions for students on an exchange program.

4.6 Term paper

The purpose of the term paper is to deepen knowledge in a certain subject, to bring students into closer contact with applications, and to enable students to take a computational approach to problems encountered in these applications. In addition, students will learn to collaborate in an existing scientific group. The term paper is written on a subject from a core course or a field of specialisation and is supervised by a lecturer. The Director of Studies CSE may approve exceptions.

The term paper requires approximately 160 hours of work. This is equivalent to about three afternoons of four hours each per semester week or four to five weeks of full-time work.

The supervisor responsible for the term paper defines the task and determines the start and the submission date.

The term paper concludes with a written report and a presentation. It is assessed as passed/not passed and earns the student 8 KP.

- Once students have decided which lecturer to work with for their term paper, they must obtain a form from the Student Administration Office D-MATH/D-PHYS, have it signed by the lecturer and return it to the Student Administration Office.

4.7 GESS

Students must attend courses of a general educational nature from the humanities, social sciences and political sciences (GESS); required attendance is 1 KP per semester (1st and 2nd semester). For more detailed information see *www.gess.ethz.ch*.

4.8 Master thesis

The Master thesis concludes the curriculum. In their Master thesis, students should demonstrate their ability to carry out independent, structured scientific work.

Only students who have completed their Bachelor studies in full or who have complied with any requirements for admission to the CSE Master Program can be admitted to the Master thesis.

The Master thesis is supervised by a professor of ETH Zürich and lasts five months. It is written on a subject from a core course or a field of specialisation. The Director of Studies CSE may approve exceptions.

The supervisor responsible for the Master thesis defines the task, the start and the submission date.

The Master Thesis concludes with a written report. The Master thesis is graded. It is equivalent to 30 KP.

- Once students have decided which professor to work with for their Master thesis, they must obtain a form from the Student Administration Office D-MATH/D-PHYS, have it signed by the professor and return it to the Student Administration Office.

4.9 Performance control

A student has passed a performance control in the categories “Core courses and compensatory courses”, “Fields of specialisation” (without seminar), “Elective courses” and “GESS” if his or her grade is at least 4.0 or his/her performance is assessed as "passed". A performance control which is not passed can be repeated once.

A semester project in the category “Case studies” which is not passed cannot be repeated. The student must attend a further course in the category “Case studies”.

A seminar in the field of specialisation or a term paper which has not been passed cannot be repeated. A further seminar must be attended, or a further term paper must be written.

The Master thesis is passed if the grade achieved is at least 4.0. A Master thesis which is not passed can be repeated once. If it is repeated, a new topic must be selected.

5. The CSE Master degree

5.1 Credit points

In order to attain the CSE Master degree, students must acquire 90 KP[6] in the following categories, including at least the number of KP shown for each category:

a.	Core Courses and compensatory courses	12 KP
	1. Core courses (5 KP) 2. Compensatory courses (0 KP)	
b.	Fields of specialisation	18 KP
c.	Elective courses	6 KP
d.	Case studies	6 KP
e.	Term paper	8 KP
f.	GESS	2 KP
g.	Master thesis	30 KP

- The minimum number of KP required in the categories is 82. A maximum of 4 KP can be credited in the GESS courses. The options offered in categories b., c. and f. should in most cases lead to the minimum number of KP required in these categories being exceeded. For the same reason, the total number of KP required – 90 – is often slightly exceeded.

- Of the 12 KP required in the category "Core courses and compensatory courses", at least 5 KP must be acquired in the subcategory "Core courses".

- KP from courses offered on both the Bachelor and the Master Program can only be credited towards the Master degree if they have not been used to earn the Bachelor degree.

5.2 Graduation

Once the requirements listed in Section 5.1 have been fulfilled, students may apply to D-MATH/D-PHYS to graduate within the maximum permitted duration of study. The Rector can extend this time limit on application if there are sufficient reasons.

The application to graduate must list the performance achieved in the categories shown in 5.1 which the student wishes to have included in the graduation certificate. The sum of KP in each category must be at least equivalent to the minimum required in each.

[6] Not including the KP (60 maximum) that may need to be earned subject to specific admission requirements

A maximum of 100 KP will be credited for the Master degree; other study achievements will be listed on a separate sheet attached to the graduation certificate at the student's request.

5.3 Grades and grade point average

Interim grade certificates are issued at the end of each exam session and document the performance that has been achieved and evaluated since the last interim grade certificate was issued.

The graduation certificate contains the following:

a. Grades and other assessments carried out in performance controls and the grade average determined on the basis of these grades;
b. On a separate sheet attached to the graduation certificate, a record of any core courses that were not passed as well as of any other evaluations of performance that were carried out.

The grade average is calculated as a weighted average from the following grades:

a.	The grades in the core courses	weight for each: 2
b.	Any grades achieved in compensatory courses	weight for each: 1
c.	The four grades from the fields of specialisation	weight for each: 1
d.	The grades from the elective courses	weight for each: 1
e.	The grade for the Master thesis	weight: 4

Once the Master degree has been conferred, graduates receive a *Degree Certificate* and a *Diploma Supplement*. The Diploma Supplement is a document that is intended to facilitate and improve the evaluation and classification of the academic degree for both study and career purposes. It contains a description of the curriculum that has been studied and successfully concluded and a *Qualification Profile* of the curriculum.

The attainment of the Master degree is published by the Rectorate.

6. Doctoral studies

ETH offers the opportunity to follow the Master Program with doctoral studies. Doctoral studies and the doctoral thesis introduce students to current research. Students require a Master degree from ETH or an equivalent degree from another university in order to gain *admission to doctoral studies*. In special cases students must sit an admission exam, the conditions of which are determined on an individual basis. The most important requirement is that a professor at ETH must be willing to supervise the doctoral thesis *(Doctoral Thesis Supervisor)*.

Candidates apply to the Rectorate in writing. The Rectorate determines the documentation which is required for enrolment and passes on the application, together with its assessment, to the department designated by the supervisor of the doctoral thesis. The Doctoral Studies Committee (*Doktoratsausschuss*) reviews the application and, after consultation with the supervisor, formulates an application to the relevant Head of Department. The Head then recommends to the Rector that the application be accepted or rejected.

Doctoral candidates produce a *research plan* in consultation with their supervisor which details the objectives and content of the *doctoral thesis*. The completion of the doctoral thesis should generally not take more than three to four years from the date of admission. The research plan is submitted to the Doctoral Studies Committee. An individual deadline is set for compliance with other admission conditions, and in general this should not be longer than one year. The Rectorate checks whether the additional admission conditions have been met.

Doctoral studies ensure that doctoral candidates receive further education in the subject on which they are writing their doctoral thesis and in other fields. Further educational activities are documented in the form of credit points (KP). KP are only awarded if the student can demonstrate independent achievement. Students are required to document the attainment of at least 12 KP. Students who complete their doctoral thesis in less than three years are required to attain proportionally fewer KP. Doctoral candidates must attain at least one third of the KP that they acquire in fields outside their own field of research.

The *Referee* (usually the supervisor) and the *Co-referee* each produce a written opinion on the doctoral thesis and submit these to the Department prior to the doctoral exam. The *doctoral exam* consists of an oral exam lasting at least one hour in the subject of the doctoral thesis. It is held by the examination committee. The doctoral exam is held no later than six years after enrolment in the doctoral studies. In exceptional cases the Rector can approve an extension based on the recommendation of the Department. The Examination Committee assesses both the doctoral thesis and the oral exam as passed or not passed and reports its results to the Departmental Conference (*Departementskonferenz*) of the department in which the doctoral candidate is enrolled. The Departemental Conference decides

whether the doctoral title is to be awarded or refused on the basis of the Examination Committee's report.

The *doctoral degree* is issued on behalf of ETH and presented to the successful candidate during the first doctoral award ceremony held after the required number of copies of the thesis have been submitted. A fee is charged for the degree.

- For more detailed information please refer to the Rules on Doctoral Studies at ETH (*Doktoratsverordnung der ETHZ*).

- In addition to carrying out research for their doctoral thesis and their doctoral studies, doctoral candidates usually also work as assistants and are thus involved in teaching activities. Employment of this kind ensures a financial basis during the doctoral period.

- Graduates of the CSE Program who wish to gain a doctoral qualification at ETH do this in the department proposed by the Doctoral Thesis Supervisor.

7. Relevant documents and addresses

Documents

The following can be obtained from the Rectorate:

a) Applicable to ETH in general

Guide to academic studies (*ETH Zürich Handbuch*)

Rules on admission to studies at ETH
(*Zulassungsverordnung ETHZ*)[7]

Rules on performance control at ETH
(*AVL ETHZ*)[7]

Rules on doctoral studies at ETH
(*Doktoratsverordnung ETHZ*)[7]

b) For the CSE curriculum [8]

Departments of Mathematics and Physics, Study Regulations 2005 for the Master Program in Computational Science and Engineering

Departments of Mathematics and Physics, Guidelines to the Master Program in Computational Science and Engineering

Departments of Mathematics and Physics, Study Regulations 2005 for the Bachelor Program in Computational Science and Engineering

Departments of Mathematics and Physics, Guidelines to the Bachelor Program in Computational Science and Engineering

Addresses

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Student Administration Office D-MATH/D-PHYS

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[7] Can also be downloaded as a PDF file from www.rechtssammlung.ethz.ch under 'Lehre'

[8] Also available from the Student Administration Office D-MATH/D-PHYS

Rectorate

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E-mail: kanzlei@rektorat.ethz.ch
www.rektorat.ethz.ch

Student Exchange Office

ETH Zentrum, HG F23.1
Tel.: ++41 (0) 44-63 26161
E-mail: www.mobilitaet.ethz.ch

Internet

The homepage of ETH (*www.ethz.ch*) provides general information about studying at ETH, in particular the documents listed under a) above, and the course syllabus for the CSE Master Program (*Vorlesungsverzeichnis*):

www.vvz.ethz.ch

Detailed information on the CSE Master Program and the CSE Bachelor Program can be found on the CSE homepage: *www.cse.ethz.ch*

The documents listed under b) above can be read on the CSE homepage or downloaded as PDF files.

Other important websites

Important links for students: www.ethz.ch/students
ETH Zürich Rectorate: www.rektorat.ethz.ch
Enrolment: https://www.mystudies.ethz.ch
ETH Student Exchange Office: www.mobilitaet.ethz.ch
International student information: www.ethz.ch/prospectives/programmes