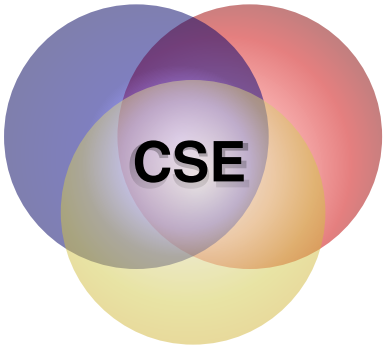
ETH
Eidgenössische Technische Hochschule Zürich
Ecole polytechnique fédérale de Zurich
Politecnico federale di Zurigo

D-MATH
Department of Mathematics



Study Guidelines for the

Bachelor Programme in Computational Science and Engineering (CSE)/ Rechnergestützte Wissenschaften (RW)

ETH Zurich

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Inhaltsverzeichnis

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Preface

These study guidelines for the Bachelor Programmme in Computational Science and Engineering (CSE) of ETH Zurich are based on the **Studienreglement 2018**[1] (document RSETHZ 323.1.0900.56, in German). This document doe not contain legally binding information. Legally binding is the Studienreglement 2018, which is available from the Collection of Regulations of ETH Zurich, and, to some extent, the entries in the ETH Zurich Course Catalogue. Additional information, further links and contact information are availabe on the CSE web pages.

In the wake of the PAKETH study reform, which will take effect from Autumn Term 2027, also the BSc RW/CSE will undergo substantial changes and you may be asked to change to new study regulations.

1 Computational Science and Engineering (CSE)/ Rechnergestützte Wissenschaften (RW)

What is RW/CSE?

RW/CSE is about gaining insights and solving problems in science and engineering using algorithms executed on computers.

The Computational Science and Engineering Study Programmes of ETH Zurich were established in response to the rapid development of computer hardware and algorithms, which has made computer-based method penetrate all fields of science and technology. Numerical simulation and computational data analysis (machine learning) are both expanding, supplementing, and even replacing traditional approaches based on experiments and theoretical considerations.

[1] Though studying at the same time, different editions of the study regulations may apply for different bachelor students of CSE. Please make sure that you refer to those Study Guidelines matching the regulations relevant for you.

The CSE programmes offer a modern education comprising basic training in mathematics, computer and data science, and some sciences, which is complemented by exposure to one or two *fields of application* from the natural or engineering sciences. The focus is on mathematical modeling, numerical simulation, efficient implementation also on cutting-edge high-performance computing platforms, and algorithms for data analysis.

CSE is *interdisciplinary*, *application-oriented* and focused on problem solving. 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. Thus, they are well equipped for successful careers in industry and business.

For more details and a list of knowledge and skills to be imparted by the CSE study programmes see Section 2 of the BSc CSE qualification profile.

2 Studying at ETH: General Information

2.1 Admission to the ETH Zurich BSc RW/CSE Programme

All applicants with a Swiss maturity certificate (“Matura”) can enroll in the BSc RW/CSE without any further requirements. Generally, admission to all study programmes at ETH is processed by the Rector’s office (in German: Rektorat), which provides students with all the relevant information, in particular on transferring from another university or switching from another study programme, on the recognition of student credits already acquired, and on any specific admission requirements.

A transfer in the second year from another ETH Zurich degree program is possible upon request and may be subject to certain conditions. **A seamless transition after the first-year curriculum from other programs has not been possible since the 2018 regulations.** Any potential change of degree program must be requested from the Registrar’s Office no later than the end of the third week of the semester.

Admission to the MSc CSE is guaranteed for graduates of the ETH Zurich BSc programme in CSE.

2.2 ETH Zurich Course Catalogue

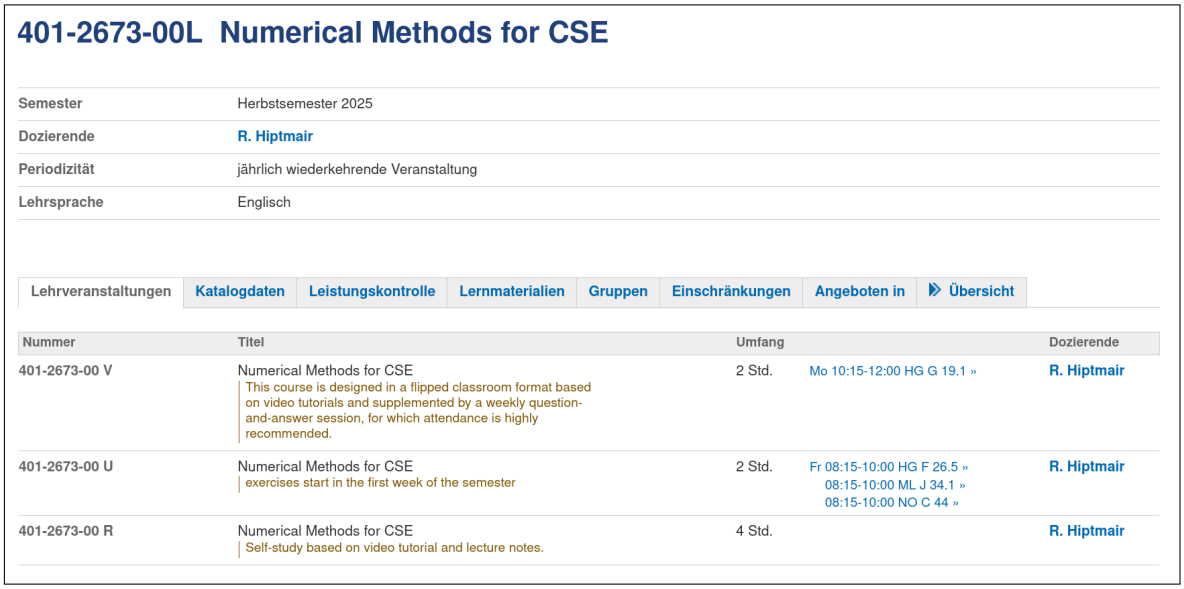
All learning units offered at ETH Zurich are published in the ETH Zurich Course Catalogue accesible via `www.vvz.ethz.ch`, which provides essential information, among others, on

- the course number, the lecturer, the language and the contents,
- the number of credits, number of hours, days, times, and rooms of classes and tutorials,
- the modalities of the performance assessment,
- special prerequisites and restrictions on attendance,
- the role of a course in various study programmes: it should be listed for “Computational Science and Engineering Bachelor”,

see Fig. 1 for an example.

A lecture that is listed for BSc RW/CSE as a core course or as a course in a specialization field can be used as an elective course *without the explicite approval* from the director of studies or from the Advisor of Studies CSE, *if it is not already taken into account as a core course or as a course in a specialization field* as part of the graduation requirements.

If you want to take a course not listed for BSc RW/CSE as an elective course, you can *request approval* from the director of studies or from the Advisor of Studies CSE **only via this** Link (“Approval of non-listed courses”).



401-2673-00L Numerical Methods for CSE

Semester	Herbstsemester 2025
Dozierende	R. Hiptmair
Periodizität	jährlich wiederkehrende Veranstaltung
Lehrsprache	Englisch

Lehrveranstaltungen | Katalogdaten | Leistungskontrolle | Lernmaterialien | Gruppen | Einschränkungen | Angeboten in | Übersicht

Nummer	Titel	Umfang		Dozierende
401-2673-00 V	Numerical Methods for CSE This course is designed in a flipped classroom format based on video tutorials and supplemented by a weekly question-and-answer session, for which attendance is highly recommended.	2 Std.	Mo 10:15-12:00 HG G 19.1 »	R. Hiptmair
401-2673-00 U	Numerical Methods for CSE exercises start in the first week of the semester	2 Std.	Fr 08:15-10:00 HG F 26.5 » 08:15-10:00 ML J 34.1 » 08:15-10:00 NO C 44 »	R. Hiptmair
401-2673-00 R	Numerical Methods for CSE Self-study based on video tutorial and lecture notes.	4 Std.		R. Hiptmair

Abbildung 1: Example: basic course information (in German) in ETH Course Catalogue as of 2025

2.3 Enrolment

All students in the BSc RW/CSE must enrol online through the MYSTUDIES portal *every semester*. They are informed by letter (first semester) or email (subsequent semesters) of the date when electronic enrolment opens. The enrolment deadline is in the end of the second week of the semester, see website.

Late enrolment will incur a fine. Failure to renew enrolment will lead to expulsion from the BSc RW/CSE after five weeks into the current semester.

BSc RW/CSE students must also register electronically through MYSTUDIES for each learning unit and examination they want to take, in order to receive information and have access to learning materials.

> Registration for examinations can be withdrawn before a specific deadline which will be communicated by email by the rector's office.
>
> If you rate your chances of passing an exam as small, contemplate withdrawal, because otherwise you squander one of your two chances to take that exam.

Some learning units impose a limit on the number of participants, and enrolment is handled on a first-come-first-served basis. Be quick to enrol as soon as it is possible through MYSTUDIES.

2.4 The European Credit Transfer and Accumulation System (ECTS) and Earning Credit Points

The rules of the ECTS stipulate that 1 credit should correspond to a workload of 25-30 hours[2], but this remains a fuzzy notion and is read very differently in different departments of ETH Zurich[3]. A learning unit can only give the number of credits stated in the course catalogue, regardless of the effort required[4].

Since RW/CSE is an interdisciplinary and interdepartmental degree program, lectures are offered by various departments. As a result, the actual workload and the relevance of the lectures for RW/C-

[2] SR BSc RW/CSE Art. 6
[3] SR BSc RW/CSE Art. 7.2
[4] SR BSc RW/CSE Art. 8.4

SE are not accurately reflected by the number of credit points (CP). Therefore, the RW/CSE study regulations also include rules that are not solely based on the number of credit points.

> The CSE Bachelr Programme is designed to cover six semesters during which students need to acquire a **minimum total of 180 ECTS credits**[a]..
>
> [a] SR BSc RW/CSE Art. 12

> The credit points assigned to a course are awarded either in full or not at all. They are awarded, if the performance assessment defined for that course has been passed, which means a grade of at least 4.0 in a graded performance assessment.
>
> All courses not included in an examination block are assessed independently, and in the case of failure, only the failed assessments or courses need to be repeated.
>
> In contrast, courses grouped into examination blocks are evaluated collectively. All exams within an examination block must be taken during the same examination session. An examination block is considered passed if the weighted average grade of the block is at least 4.0. In this case, credit points are awarded for all courses within the block, even if individual grades are below 4.0. However, if the examination block is not passed, all exams within the block must be retaken. Attending the courses again is optional.
>
> A student need to repeat and is allowed to repeat only those performance assessments or courses or blocks, which he or she has failed at the first attempt. **The number of attempts to pass a course is strictly limited to two**[a]**.**
>
> [a] Leistungskontrollverordnung ETH Zürich Art. 14

The credit points for BSc RW/CSE students are handled by the Study Administration Office D-MATH and the MYSTUDIES portal gives you complete information about credits earned by you so far.

2.5 Student Mobility Semesters at Other Universities

BSc RW/CSE students may earn a maximum of 30 ECTS credits towards their BSc degree at another university.

Before starting the mobility semester, BSc RW/CSE students must devise a written study plan in collaboration with the Advisor of Studies Rw/CSE, currently Dr. Vasile Gradinaru. This plan must detail the study achievements that the student expects to attain at the host university. The study plan must be approved by the Director of Studies RW/CSE or by the Advisor of Studies Rw/CSE. Interested students should gather information by themselves and contact the Advisor of Studies CSE early on, since the application process may take a long time.

Further information about mobility semesters (administrative matters, scholarships, etc.) can be obtained from the Advisor of Studies CSE and the Student Exchange Office of ETH Zurich.

2.6 BSc Graduation

When an BSC CSE student has acquired the necessary number of credit points in various categories of learning units, he or she can *request* that the **Bachelor Degree** be awarded.

This request must be submitted to the Study Administration of D-MATH via MYSTUDIES and must list all the study achievements that should be included in the final academic record (in German: Schlusszeugnis). The sum of credits in each category must be at least equal to the required minimum number. The final academic record lists the study achievements and, if applicable, the associated grades, other evaluations of performance, and the grade average calculated from the grades achieved (excluding subjects from the “Science in Perspective” category). Sometimes the students have to decide by themselves, to which category a study achievement is to belong. In case the student cannot specify the category in MYSTUDIES, he or she should ask the Study Administration of D-MATH to make the

changes. Once the Bachelor Degree has been awarded, graduates receive a degree certificate and a diploma supplement. Study credits that are not used towards the degree will appear on a separate sheet.

The BSc RW/CSE students who graduated in a particular year will receive an invitation to a **CSE Bachelor Graduation Reception** usually held on the occasion of the start-of-autumn-term event in that year.

2.7 Maximum Duration of Studies

Students must request the BSc degree to be awarded *within five years* of starting the CSE Bachelor Programme[5].

The Rector's office may extend the maximum duration upon written request, which has to argue convincingly that special circumstances (e.g. health problems, military service, family emergencies) apply.

In general, at ETH it is the student's responsibility to watch deadlines and submit requests for extension and exceptions in time. You may not be reminded!

2.8 Termination of BSc Studies without Graduation

Students who will not be able to earn the necessary number of credit points because they have failed some performance assessments twice or because it will no longer be possible for them to complete the curriculum within the maximum permitted duration, will be excluded from the curriculum[6]. Those who terminate their studies or are excluded from the curriculum will receive a certificate showing all the study achievements[7]. It goes without saying that re-enrollment in the BSc RW/CSE is not possible.

2.9 Perfomance Assessments (Examinations)

Rules of performance assessments/examinations are set globally for ETH Zurich in the ETH Ordinance on Performance Assessments.

The performance assessment stipulated for each course is shown in the course catalogue (`www.vvz.ethz.ch`), see Section 2.2, and that information is binding. The performance assessment for most courses is a written or oral examination. The type of performance assessment for a course is decided by the department offering the course.

2.9.1 Grades

Exams and the Bachelor theses are always awarded a grade. Other learning units may be evaluated on a pass-fail basis. The top grade is 6.0, the passing grade is 4.0, the lowest is 1.0; half and quarter grades within this range are commonly given. Roughly, the meaning of the grades is the following:

$$6.0 \mathrel{\widehat{=}} \text{outstanding (A+)},\quad 5.5 \mathrel{\widehat{=}} \text{very good (A)},\quad 5.0 \mathrel{\widehat{=}} \text{good (B)},$$
$$4.5 \mathrel{\widehat{=}} \text{satisfactory (C)},\quad 4.0 \mathrel{\widehat{=}} \text{sufficient (D)},\quad < 4.0 \mathrel{\widehat{=}} \text{fail (F)}$$

2.9.2 Examination

Examinations ("session examinations") are mostly scheduled during **examination periods**, also called **examination sessions**. There are two exam periods every year, which apply to all ETH curricula. Examinations held during the exam periods are coordinated centrally by the Rector's office. An interim certificate is issued after each exam session, showing the grades achieved since the last interim certificate was issued.

The format of the exam (**written** or **oral**, duration of exam, admitted aids) are shown in the examination plan. Oral examinations are conducted either by two examiners or by one examiner and an

[5] SR BSc RW/CSE Art. 12
[6] SR BSc RW/CSE Art. 47
[7] SR BSc RW/CSE Art. 48

assistant. The exam for a course which is offered regularly is always based on the most recent edition of that course and is prepared by the lecturers who taught it.

If students postpone taking an exam, there is a risk that the lecturer will change, which may imply a substantial change in course content. Students cannot ask to be examined by a particular lecturer for either a first-attempt or a repetition exam. For these reasons it is recommended that students should sit the exam right after having attended the course.

2.9.3 Admission to Examinations

Admission to an exam may be made conditional on fulfilling requirements concerning exercises or projects assigned during the course in question[8]. Exam admission requirements of this kind have to be announced at the beginning of the semester and are also listed in the course catalogue (www.vvz.ethz.ch), see Section 2.2.

2.9.4 Registration for and Withdrawal from Examinations

The rector's office announces the exam venues and deadline for registration for examinations to be held in an examination period[9]. Registration has to be done online about halfway through the preceding semester. Registration for a lecture will also involve registration for all associated performance assessments scheduled outside the examination period like end-of-term examinations of particular projects.

Registration can be withdrawn without justification until the first day of the examination session. If the exams are part of an examination block, withdrawing the registration applies to the entire examination block.

2.9.5 Interruption of Examination Periods

The taking of examinations during an examination period may only be interrupted for important reasons such as illness or an accident[10]. A student who interrupts an examination period must inform the examination office immediately and submit the necessary doctor's certificate.

If a student fails to provide sufficient justification for missing a performance assessment, the assessment is considered failed. If the assessment is part of an examination block, the entire examination block is considered failed. Exams taken before an interruption in an examination session remain valid and will be credited upon continuation.

2.9.6 Decision on Performance Assessments, Grading Conference

At the end of each examination session, a grading conference is held under the direction of the program director. This conference decides on all performance assessments related to examination blocks based on proposals and with the participation of all involved examiners. The decision is made only after all exams within the examination block have been completed. Two student representatives are allowed to attend each grading conference as observers.

2.9.7 Review and Appeal

After receiving the results of each written assessment, all participants have the opportunity to review their submitted materials. Any appeal regarding an incorrect evaluation of the assessment should first be directed to the examiner or the program director.

2.9.8 Repetition of performance assessments

A performance assessment which has been passed cannot be repeated. A performance assessment which has been failed can be repeated *only once*. If a student fails twice, the performance assessment is considered to have been failed irrevocably.

[8] Leistungskontrollverordnung ETH Zürich Art. 8
[9] Leistungskontrollverordnung ETH Zürich Art. 9
[10] Leistungskontrollverordnung ETH Zürich Art. 10

Students who fail irrevocably in mandatory courses or blocks will be excluded from th study programme.

Students who ultimately fail a non-mandatory course must choose another such course.

> The best way to prepare for exams is to follow the lectures closely throughout the semester, solve the exercises independently, and immediately clarify any uncertainties with the responsible assistants or lecturers. To supplement learning and fill any gaps, students should also refer to textbooks.
> For immediate exam preparation, it is advisable to create a study plan that allocates time for each subject. In addition to reviewing the theoretical concepts taught in lectures, thoroughly working through the exercises is essential. Assistants and lecturers are also available for questions during the preparation period.

Repetition usually disrupts individual study plans, because courses and other exams may have to be postponed. Think carefully about how to reorganize your studies, when forced to repeat exams. Do not pack to many exams into a single examination period, because an increased risk of failure may result in cascading forced repetitions. Seek advice from the Advisor of Studies of the BSc RW/CSE in time.

2.10 Master's Programs

The RW Bachelor's degree grants admission without additional requirements to the RW/CSE Master's program at D-MATH.

On one hand, as a BSc RW/CSE student one can already register as MSc CSE Student when all compulsory examination blocks of the first two years of BSc RW/CSE have been passed and no more than 30 credits are missing towards fulfilling the requirements for the BSc RW/CSE diploma.

On the other hand, a BSc RW/CSE student can take courses and aquire credits for the MSc CSE without having to be registered as a MSc CSE student up to the start of the MSc Thesis and up to some exceptional learning units, for which lectures may have restricted access restricted to MSc students. The achieved credits that are not needed for the BSc RW/CSE diploma may be transfered into the MSc CSE upon request and after registration as a MSc student.

The conditions for admission to other Master's programs are specified in the respective study regulations. The number of credit points not used towards the BSc RW/CSE and and eligible for transfer to other MSc programmes are defined in the corresponding programme regulation of the receiving MSc programmes.

> A BSc degree in RW/CSE is not regarded as sufficient qualification for a career as a professional in the field. The BSc RW/CSE is mainly meant to impart knowledge and skills that enable students to succeed in the MSc CSE or a related MSc programme. Graduating with a Master Degree must be the goal from the very beginning.

ETH offers the opportunity to continue the Master programme with doctoral studies. These are not directly related to the CSE Master programme and there is no direct doctorate in relation with the CSE Master programme, yet the CSE Master diploma is a good qualification to be used when applying for admission to doctoral studies. Admission to a PhD programme at ETH crucially depends on the willingness of a professor to act as a supervisor.

2.11 Didaktikzertifikat und Lehrdiplom

Planen Sie mit einem Abschluss in RW/CSE Lehrer an einer weiterführenden Schule zu werden? Wenn ja, dann bedarf das langfristiger Vorbereitung, denn es gibt kein einem Abschluss in RW/CSE zugeordnetes Didaktikzertifikat oder Lehrdiplom. Die verwandten Lehrdiplome in den Fächern Mathematik und Informatik verlangen fachliche Voraussetzungen, die nur durch Bestehen von (zahlreichen) zusätzlichen *Auflagenfächern* erfüllt werden können. Bitte wenden Sie sich an Prof. Norbert Hungerbühler vom D-MATH, um sich beraten zu lassen.

2.12 Governance of BSc RW/CSE

The following bodies and units at ETH can make decisions affecting the BSc RW/CSE study programme as a whole or individual students:

- The Rector's office, in particular the admission and examination offices;
- The **CSE committee**, the governing body for MSc and BSc programmes in CSE;
- The **Director of Studies** for the CSE Study Programmes, currently Prof. Ralf Hiptmair (D-MATH);
- The **Advisor of Studies** CSE, currently Dr. Vasile Gradinaru (D-MATH);
- The **Teaching Committee** CSE (in German: Unterrichtskommission); it is composed of three lecturers, three mid-level scientific staff, and *three student representatives*.

Administrative services for the BSc RW/CSE are provided by the Study Administration of D-MATH. They should be contacted concerning issues that cannot be resolved through MYSTUDIES.

The Director and Advisor of Studies regularly invite all students of the CSE study programmes for meetings in order to learn about strengths and weaknesses of the programmes from the perspective of students. The information gleaned during these meetings has had and continues to have a significant impact on the development of the study programmes. Attendance is highly recommended!

2.13 Student Organizations and Services

The students enrolled in RW/CSE programmes at ETH Zurich are represented by VMP a student association within the umbrella organization VSETH. The VMP offers important services like maintaining exam collections and exam prep courses. Also the services provided by the student association VIS of computer science students may offer services and activities relevant for BSc RW/CSE.

Representing you: `[rw::ko]`

A special body within VMP is `[rw::ko]`, the commission for RW/CSE matters. At least visit the website; even better, get in touch, get involved!

3 The CSE Bachelor Programme

The language of instruction in the BSc RW/CSE is German or English[a]. In general, the lectures of the first year are taught in German.

[a] SR BSc RW/CSE Art. 14

3.1 First Year/Basisjahr: Introductory Courses

Compulsory 1. Year Courses in Autumn Semester	h/week	Dep.	CP
Linear Algebra	3V + 2U	MATH	5
Discrete Mathematics	4V + 2U	INFK	7
Computer Science	2V + 2U + 2P	INFK	6
Analysis 1	4V + 3U	MATH	8
Physics I	3V + 1U	PHYS	4

Compulsory 1. Year Courses in Spring Semester	h/week	Dep.	CP
Analysis 2	4V + 2U	MATH	8
Mathematical Methods	3V + 2U	MATH	4
Physics II	3V + 1U	PHYS	4
Chemistry	3G	CHAB	4
Data Structures and Algorithms	4V + 2U	INFK	8

The first-year examinations are meant to be “entrance exams” for ETH. They cover much material, are rather demanding, and see a significant dropout rate. Failure by a large margin in first-year exams (“Basisprüfungsblöcke”) indicates a student’s lack of essential talent for the chosen study programme. In this case the *studies should be terminated* rather sooner than later, unless the poor performance in the exams can be blamed on special temporary circumstances.

3.2 Second Years: Foundational courses

Basic Courses in Autumn Semester	h/week	Dep.	CP
Analysis 3	2V + 2U	MATH	4
Introduction to Mathematical Optimization	2V + 1U	MATH	5
Numerical Methods for CSE	2V + 2U + 4R	MATH	9
Programming Techniques for Scientific Simulations I	4G	MATH	5
Systems Programming and Computer Architecture	4V + 2U	INFK	7

Basic Courses in Spring Semester	h/week	Dep.	CP
Numerical Methods for Partial Differential Equations	2G + 2U + 2P + 4A	MATH	10
Probability Theory and Statistics	2V + 1U	MATH	4
Fluid Dynamics	12V + 4U	MAVT	8
Statistical Physics and Computer Simulation	2V + 1U	CHAB	6

3.3 Third Year: Core Courses

Each student has to pass three of the following four Core Courses.

Core Courses in Autumn Semester	h/week	Dep.	CP
Software Engineering	2V + 2U	INFK	6
Design of Parallel and High-Performance Computing	2V + 2U + 4A	INFK	9

Core Courses in Spring Semester	h/week	Dep.	CP
High-Performance Computing Lab for CSE	4G + 1P	MATH	7
Introduction to Machine Learning	4V + 2U + 1A	INFK	8

(Explanation of abbreviations: x**V** $\triangleq$ x classroom lectures per week, x**U**, x**A**/**P** $\triangleq$ x hours of project work per week, x**G** $\triangleq$ x total hours per week, h/week $\triangleq$ hours per week, CP $\triangleq$ Credit Points, Dep. or D- $\triangleq$ Department, MATH $\triangleq$ Mathematics, INFK $\triangleq$ Computer Science, BSSE $\triangleq$ Biosystems Science

and Engineering, ITET ≙ Information Technology and Electrical Engineering, MAVT ≙ Mechanical and Process Engineering, MATL ≙ Materials, BIOL ≙ Biology, CHAB ≙ Chemistry and Applied Biosciences, PHYS ≙ Physics, EAPS ≙ Earth and Planetary Sciences, USYS ≙ Environmental Systems Science, HEST ≙ Health Sciences and Technology, see the complete list of ETH Departments.)

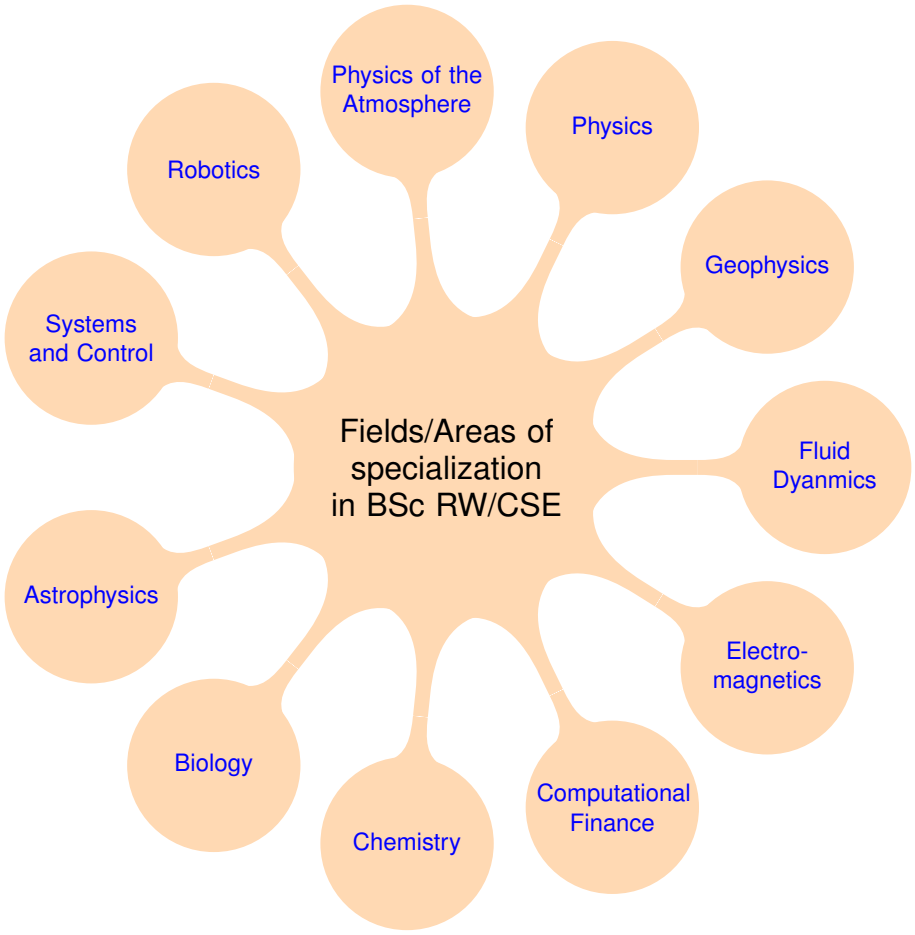
Details concerning courses given in this document may not be up to date. Please refer to the ETH Zurich Course Catalogue for authoritative information.

3.4 Third Year: Fields/Areas of Specialization

The fields/areas of specialization provide in-depth knowledge of applications of computer simulation and methods of computational science and engineering.

Two courses must be passed in the category **fields/areas of specialization**.

3.4.1 Currently Possible Fields/Areas of Specialization



3.4.2 Courses in the fields of specialization

The following tables list the course portfolio for every field of specialization in the BSc RW/CSE. Only these courses can yield credits in the category “field of specialization:”. However, the details in the tables of this document may be outdated. Please refer to the ETH Zurich Course Catalogue for current information. Some of the course units are offered only every other semester. Therefore, courses may have to be taken in an order not complying with recommendations given in the course catalogue.

Some of the courses have been tagged with warning signs:

Some of the lectures are offered only by the University of Zurich (UZH).
In order to take lectures from UZH, students *have to register as exchange student to UZH* and book the UZH lectures *no later that one week before the official start of the semester*! You must not miss the announced deadlines.

Some of the course units are offered only as compact block course taking place during one or two weeks in the semester breaks.

Some of the course units may impose a limit on number of students. In this case admission may be handled on a “first come, first served” basis. Be quick to register immediately after registration has been opened in MYSTUDIES.

We point out that all courses listed for the various areas of specialization have been designed for audiences of non-CSE students, mostly students of study programmes in a particular domain of science and engineering. Thus, some courses may take for granted prior knowledge that CSE students lack. Consult the course catalogue for information about prerequisite knowledge and brace for the need to acquire it through *self-study*. Do not hesitate to ask the lecturer or head assistant for advice.

(a) Astrophysics (*Contact*: Lucio Mayer, Astrophysics, Zurich University)

Courses in Autumn Semester	h/week	Dep.	CP
Theoretical Astrophysics (University of Zurich)	4V + 2U	UZH	10
Computational Astrophysics (University of Zurich)	2V	UZH	6

Courses in Spring Semester	h/week	Dep.	CP
Physical Cosmology (University of Zurich)	4V + 2U	UZH	10

(b) Biology (*Contact*: Jörg Stelling, D-BSSE)

Courses in Autumn Semester	h/week	Dep.	CP
Computational Systems Biology	3V + 2U	BSSE	6
Spatio-Temporal Modelling in Biology	3G	BSSE	4
Introduction to Neuroinformatics	2V + 1U + 1A	ITET	6

Courses in Spring Semester	h/week	Dep.	CP
Statistical Models in Computational Biology	2V + 1U + 2A	BSSE	6

(c) Chemistry (*Contact*: Philippe Hünenberger, D-CHAB)

Courses in Autumn Semester	h/week	Dep.	CP
Classical Simulation of (Bio)Molecular Systems	4G	CHAB	6
Quantum Mechanics I	3V + 2U	PHYS	8

Courses in Spring Semester	h/week	Dep.	CP
Quantum Chemistry	3G	CHAB	6
Molecular and Materials Modelling	2V + 2U	ITET	6

(d) Computational Finance (*Contact*: Josef Teichmann, D-MATH)

Courses in Autumn Semester	h/week	Dep.	CP
Mathematical Foundations for Finance	3V + 2U	MATH	4
Numerical Solution of Stochastic Ordinary DifferentialEquations	3V + 1U	MATH	6

Courses in Spring Semester	h/week	Dep.	CP

Some courses in this field of specialization require mathematical foundations in measure theory and probability beyond what is covered in standard courses in the BSc CSE. When you chose Computational Finance as your field of specialization, it is your own responsibility to familiarize yourself with the prerequisite knowledge through self-study. Carefully examine the information published in the course directory and on course websites.

(e) Electromagnetics (*Contact*: Jasmin Smajic D-ITET)

Courses in Autumn Semester	h/week	Dep.	CP
Physical Modelling and Simulation	4G	ITET	6
Introduction to Photonics	2V + 2U	MAVT	4

Courses in Spring Semester	h/week	Dep.	CP
Optimization Methods for Engineers	2G	ITET	3

(f) Fluid Dynamics (*Contact*: Patrick Jenny, D-MAVT)

Courses in Autumn Semester	h/week	Dep.	CP
Stochastic Methods for Engineers and Natural Scientists	4G	MAVT	4
Hydrodynamics and Cavitation	3G	MAVT	4

Courses in Spring Semester	h/week	Dep.	CP
Computational Methods for Flow, Heat and Mass TransferProblems	4G	MAVT	4

The course “Computational Methods for Flow, Heat and Mass Transfer Problems” is compulsory.

(g) Geophysics (*Contact*: Paul Tackley, D-EAPS)

Courses in Autumn Semester	h/week	Dep.	CP
Continuum Mechanics	2V	EAPS	3
Numerical Modelling I and II: Theory and Applications	4G	EAPS	6
Seismic Waves II	2G	EAPS	3
Seismic Waves I	3G	EAPS	3
Numerical Modelling in Fortran	2V	EAPS	3

Courses in Spring Semester	h/week	Dep.	CP
Dynamics of the Mantle and Lithosphere	2G	EAPS	3
Numerical Modelling for Applied Geophysics	3G	EAPS	4
Seismic Waves I	3G	EAPS	3
Inverse Theory I: Basics	2V	EAPS	3
Inverse Theory II: Applications	2G	EAPS	3

The following constraints apply to the selection of courses:

- Mandatory courses in the field of specialization geophysics are: “Numerical Modelling I and II: Theory and Applications”, “Seismic Waves I”, and “Seismic Waves II”.
- These have to be combined with
  + *either* “Inverse Theory I: Basics” and “Inverse Theory II: Applications”,
  + *or* “Numerical Modelling for Applied Geophysics” and “Numerical Modelling in Fortran”
  + *or* “Continuum Mechanics”
  + *or* “Dynamics of the Mantle and Lithosphere”.

(h) Physics (*Contact*: Andreas Adelmann, D-PHYS and PSI)

Courses in Autumn Semester	h/week	Dep.	CP
Introduction to Computational Physics	2V + 2U	PHYS	8
Quantum Mechanics I	3V + 2U	PHYS	8

Courses in Spring Semester	h/week	Dep.	CP
Computational Statistical Physics	2V + 2U	PHYS	8
Computational Quantum Physics	2V + 2U	PHYS	8
Molecular and Materials Modelling	2V + 2U	ITET	6

(i) Physics of the Atmosphere (*Contact*:Hanna Joos, D-USYS)

Courses in Autumn Semester	h/week	Dep.	CP
Atmosphere	2V	USYS	3

Courses in Spring Semester	h/week	Dep.	CP
Weather and Climate Modeling	2V + 1U	USYS	4

(j) Robotics (*Contact*: Roland Siegwart, D-MAVT)

Courses in Autumn Semester	h/week	Dep.	CP
Image Analysis and Computer Vision	3V + 1U	ITET	6
Advanced Machine Learning	3V + 2U + 4A	INFK	10
Deep Learning	3V + 2U + 2A	INFK	8
Dynamic Programming and Optimal Control	2V + 1U	MAVT	4
Robot Dynamics	2V + 2U	MAVT	4
Computer Vision	3V + 1U + 3A	INFK	8
Probabilistic Artificial Intelligence	3V + 2U + 2A	INFK	8

Courses in Spring Semester	h/week	Dep.	CP
Autonomous Mobile Robots	4G	MAVT	5
Recursive Estimation	2V + 1U	MAVT	4
3D Vision	3G + 1A	INFK	5
Introduction to Machine Learning	4V + 2U + 1A	INFK	8

The following pairs of courses are mutually exclusive; only one can contribute credits for the MSc CSE:

“Computer Vision”	or	“Image Analysis and Computer Vision”
“Probabilistic Artificial Intelligence”	or	“Advanced Machine Learning”

The lecture “Probabilistic Artificial Intelligence” is *both* a core course and a course in the field of specialization Robotics. Of course, the credits can be used only in either category. If you have passed that course, please inform the Study Administration about which category it should be assigned to.

(k) Systems and Control (*Contact*: John Lygeros, D-ITET)

Courses in Autumn Semester	h/week	Dep.	CP
Control Systems	2V + 2U	ITET	6
Signals and Systems I	2V + 2U	ITET	4

Courses in Spring Semester	h/week	Dep.	CP
Computational Control	2V + 2U	ITET	6
Signals and Systems II	2V + 2U	ITET	4

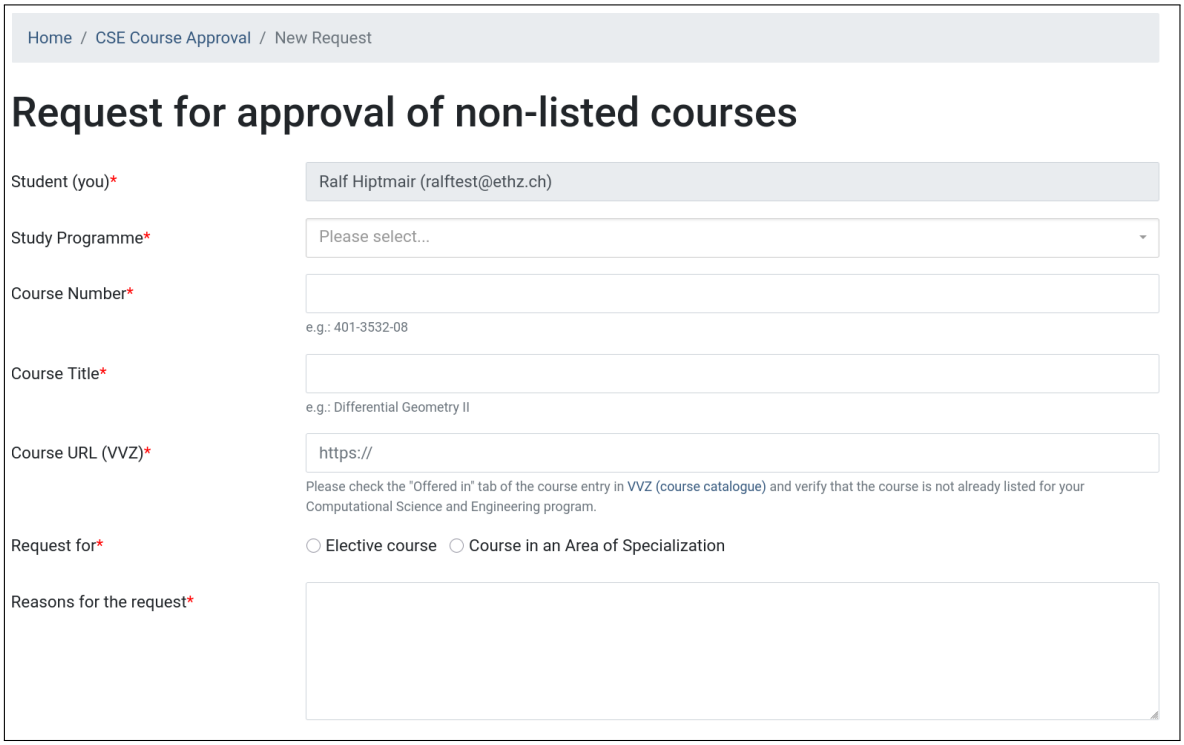


Abbildung 2: Form for requesting permission to take a particular course as an elective or for an area of specialization in the BSc RW/CSE

3.5 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 pass the associated exams.

The courses from which students may select are listed in the ETH Zurich Course Catalogue. Courses in the fields of specialization may also be chosen as elective courses provided that they are not already taken into account for the student's chosen fields of specialization. The Director of Studies CSE or the Study Advisor CSE may approve additional elective courses on request **only via this** Link, see Fig. 2.

3.6 Case Studies Seminar

The Case Studies Seminar is a special teaching format. It comprises

1. presentations by experts from within and outside ETH Zurich, also outside academia (industry and services) on applications of CSE-related methods in their domain, and
2. short 10-minute presentations by participating students, covering published research or own projects. Students have to submit the topic of their presentation online in the beginning of the semester, see Fig. 3.

   Longer research articles may be presented jointly by several (up to three) students.

The Case Studies Seminar is offered every semester. It is merely assessed as passed/failed and yields three ECTS credits. In-person attendance is *compulsary* and signing the attendance list is requested. Students in the BSc RW/CSE Programme have to attend and pass the Case Studies Seminar *twice*. The Director of Studies CSE may approve exceptions for students taking part in an exchange programme.

3.7 Science in Perspective

Students must attend courses of a general educational nature from the humanities, social sciences and political sciences (Science in Perspective). They must earn at least 6 credit point in this category.

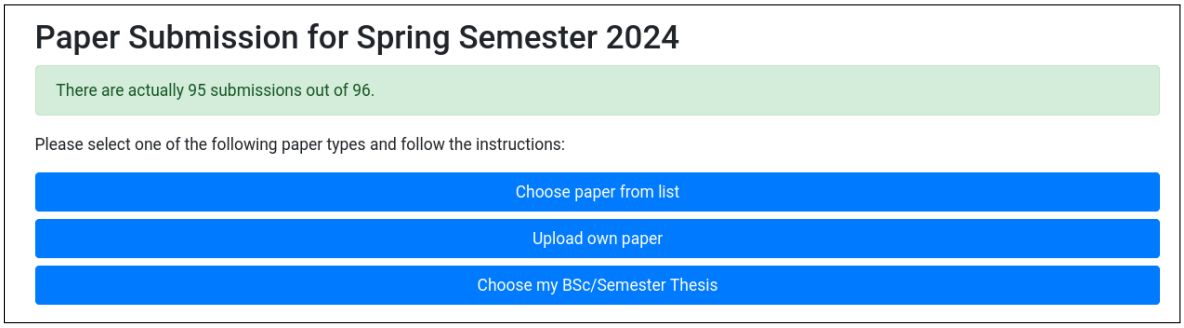


Abbildung 3: Online submission form for student presentations in the Case Studies Seminar

For more detailed information see www.gess.ethz.ch.

3.8 Bachelor Thesis

The Bachelor thesis concludes the BSc RW/CSE curriculum and can be conducted no earlier than the third year of study (5th/6th semester). ts purpose is to deepen knowledge in a specific subject area, provide initial exposure to practical applications, and tackle problems using computational methods. Additionally, students will gain experience working within an established research group. The thesis must be carried out within the scope of a core subject or specialization area, and in some cases, within a foundational course.

The BSc thesis project is usually supervised and graded by a lecturer in charge of teaching a Core Course or a course in a Field of Specialization, but *any* other *lecturer of ETH Zurich*, who is entitled to supervise bachelor or master thesis in her or his own department is also eligible. If a bachelor thesis project is conducted at a research institution or outside ETH Zurich or even in industry, an authorized lecturer of ETH Zurich must take responsibility as supervisor. It is the student's responsibility to get in touch with potential supervisors or to obtain information on BSc thesis projects offered by research groups at ETH Zurich or outside ETH Zurich.

The topic of a Bachelor thesis project must be approved by the Director of Studies CSE. To that end, a detailed request including a one page project description has to be submitted **only via** the form, see Fig. 4. The BSc thesis project description must convey that the following requirements are satisfied:

> A project in CSE must involve the application of core CSE techniques and must have a strong software implementation component. Algorithm development and implementation, numerical or discrete modeling, or simulations must constitute the main contribution of the student to the project.

Once the topic and the supervision have been approved by the director of studies, the student must submit an electronic registration form to the D-MATH Study Secretariat via myStudies.

The Bachelor's thesis requires 420 hours of work and can be completed on a full-time or part-time basis.

The supervisor responsible for the Bachelor thesis defines the task, the starting and submission dates, of course, in compliance with the maximum duration. The Bachelor thesis has to be submitted in the form of a written report and will be graded. The Bachleor thesis is passed if the grade achieved is at least 4.0. A passed Bachelor thesis earns 14 credit points. A failed Bachelor thesis can be repeated once, necessarily on a new topic and with a different supervisor.

3.9 Summary: Required Study Achievements

The RW/CSE Bachelor's program at D-MATH spans three academic years (1st–6th semester). A passed first year exam accrues 56 credit points. In the remaining two years of the Bachelor's program, another at least 56 credit points must be earned in mandatory foundational courses. The other credits are obtained through mandatory core courses, freely chosen electives, lectures in the specialization areas, and a Bachelor's thesis.

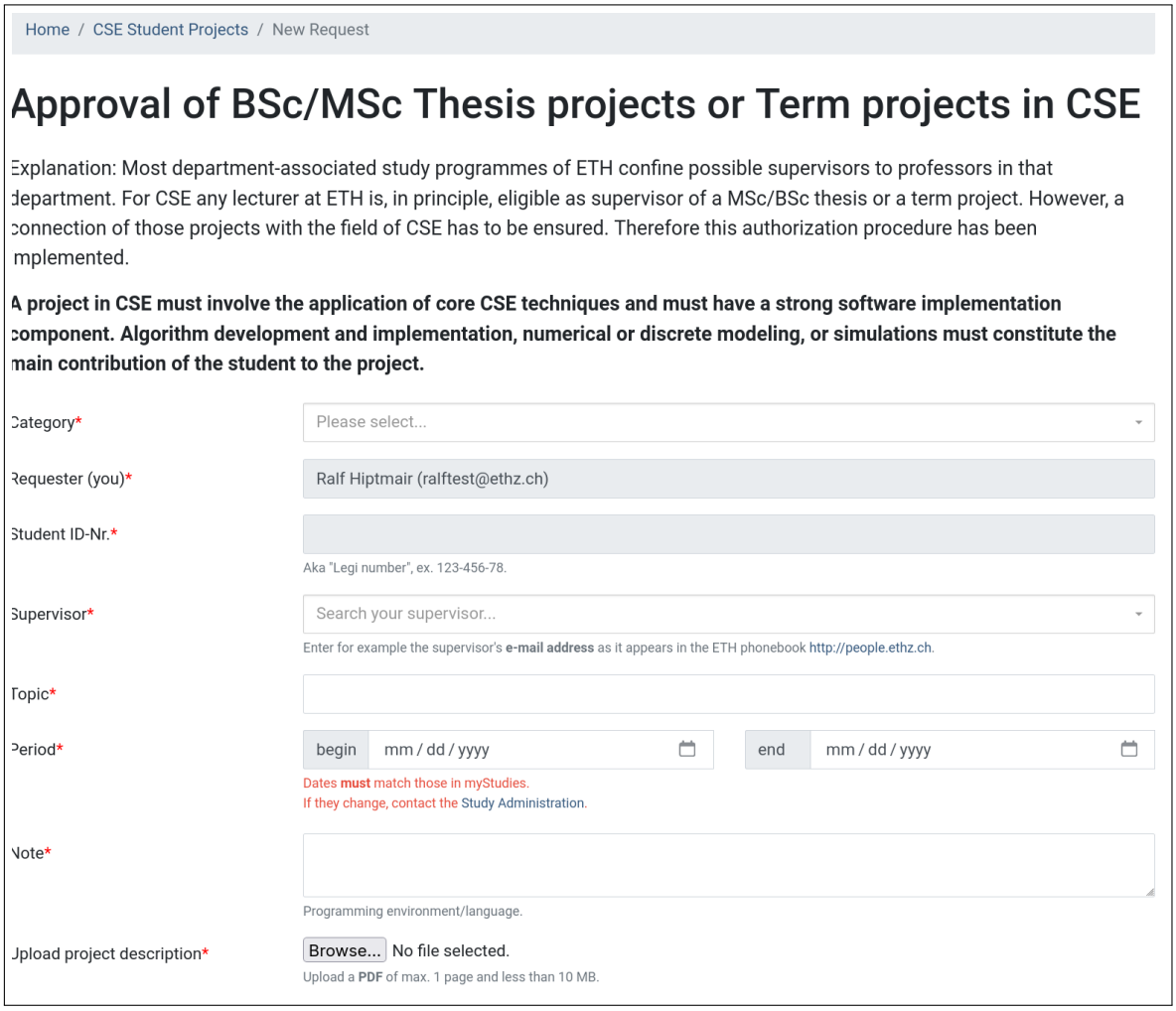


Abbildung 4: Form for requesting approval of a topic for a BSc/MSc thesis or term project in RW/CSE

In order to obtain the CSE Bachelor degree, students must acquire **180** credit points in the following categories:

1. First year courses: $\geq$**56** credits;
   - foundation courses: $\geq$**56** credits;
   - three core courses: $\geq$**20** credits;
   - two courses from a field of specialization: **6** credits;
   - at least two elective courses: **6** credits;
2. Case studies: **6** credits;
3. Science in perspective: **6** credits;
4. Bachelor thesis: **14** credits.

The ECTS credit numbers show the *minimum* number of credits to be earned in each category. The *missing credit points up to the required credits have to be earned in elective courses*.

Credit points from courses offered on both the Bachelor and the Master programme can only be counted towards the MSc degree, if they have not been used for the BSc degree.

Other study achievements that cannot be counted towards the BSc degree, e.g. those not fitting within the maximum of **195** credit points, will be listed on a separate sheet attached to the graduation certificate at the student's request.

Mandatory *once* during the BSc or MSc studies is the course unit Scientific Works in Mathematics or Scientific Works in Physics. It has to be attended successfully in either autumn or spring term.

3.10 Calculation of the Final Grade

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

- Grades and other achievements earned in performance assessments and the grade average determined on the basis of these grades;
- 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 the student took part in.

The final grade is calculated as the weighted average of the grades listed in the diploma application. Additionally, the following rules apply:

a. The grades from the foundational examination blocks 1 and 2, as well as any grades in the SScience in Contextcategory, are not considered in the final grade.

b. The grade of an examination block is the calculated average grade of that block.

c. The weight of a grade in the diploma corresponds to the number of credit points assigned to the respective learning unit. If it is the grade of an examination block, its weight corresponds to the total number of credit points earned by passing the block.

Once the Bachelor 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.