



B Mathematical Engineering

35168

TER 21-22 Bachelor

O&I

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# PART 1. INTRODUCTION

## 1. Contents of the TER

These Teaching and Examination Regulations provide students with information about teaching and testing of the B Mathematical Engineering (CROHO-number: 35168). In this document, we refer to the Teaching and Examination Regulations as 'the TER'.

The TER also contains the rules that apply to teaching and testing.

The TER concerns teaching in the programme in all forms and variants, for both the September and February intakes.

As well as regular students (further referred to simply as 'students'), higher education programmes can include external students. Enrolment as an external student only entitles the student to take tests, not to attend classes. The TER only applies to students. The provisions relating to testing and examinations also apply to external students.

## 2. Organisation of this document

We expect students to be familiar with the contents of the TER. That does not mean that everyone has to learn the text by heart, but students who have general questions or problems should first check to see whether the TER can clarify the matter. Students can do a quick check for information by using the table of contents or the index. Note: the index does not indicate every single place where a word or concept is mentioned, but it does point to the place where the definition or key information can be found.

The TER applies to all students, regardless of when they first enrolled. This means that what was written in last year's TER does not automatically apply this year. Changes may have been made. Students who have to repeat or make up a component from a previous year therefore cannot assume that everything will still be the same. It is important to check the content, procedures and rules for this year in good time.

As much as possible, we explain the concepts that we use in this TER within the part of the text that deals with that concept. But we sometimes need to use a concept that we haven't already explained. In that case, you can use the index to find the definition of the concept.

The TER consists of ten parts. Most of these are further divided into chapters. All topics covered by the chapters have a heading in bold. These headings appear in the table of contents. These components (articles) are numbered sequentially, from Article [1](#) to Article [185](#).

## PART 2. THE EXAMINATION BOARD AND THE TER

### 3. The Examination Board

The programme has an Examination Board. More information on the Examination Board can be found on Moodle in the course of the Exam Board.

Chapter 2 of the Education Guide contains a comprehensive explanation of the duties and powers of the Examination Board.

The university believes it is important to have professionally run Examination Boards which:

- / are conscious of their independent and expert task of keeping a 'watchful eye' over the programmes, to ensure they are at an appropriate level of higher professional education;
- / perform their work in accordance with the applicable laws and regulations; and
- / occupy a strong position as an independent advisory body for the faculty director and programme management.

The TER describes the duties and powers of the Examination Board just as they are described in the Dutch Higher Education and Research Act (Wet op het hoger onderwijs en wetenschappelijk onderzoek, or WHW).

In individual cases, the Examination Board may decide to deviate from a rule in this TER.

Students must always submit a request for a deviation. Via this [link](#) students can read how and to whom they can submit requests. If there are special or personal circumstances, students should mention these as soon as possible.

The Examination Board handles requests only if they are submitted within the specified timeframe. If no timeframe is specified, students may submit requests at any time. Requests should be submitted as soon as possible. The Examination Board needs time to properly consider requests.

The Examination Board will specify the requirements that requests must meet and the supporting documents that must be included with requests.

For some matters, the TER specifies a timeframe within which an Examination Board will make its decision. The timeframe is expressed in working days. 'Working day' means any day from Monday up to and including Friday. The following days are not working days:

- public holidays set by the government;
- days on which the university is closed, as specified in the annual calendar.

For other requests and complaints, the decision-making timeframe is specified in the digital form which students must use to submit their request or complaint.

If a request is incomplete or was not submitted in the correct manner, the timeframe will start to run only when:

- the request has been correctly submitted;
- and the student has supplied all necessary information.

### 4. Disagreeing with a decision made under the TER

In Chapter 2 of this Education Guide and on Iris, under Knowing & Arranging, [Objection and Appeal](#), students can find a list of decisions by the Examination Board, an examiner or the faculty director, against which a student can lodge an appeal or objection. It is also explained what 'objection' and 'appeal' mean and what the procedure is.

For all decisions that are subject to objection or appeal, the process and timeframes for submitting an objection or appeal are specified.



## PART 3. TEACHING

### Chapter 1. Objectives and professions for which students are trained

#### 5. Objectives, professional requirements and degree

The programme trains students to develop initial ability into professionalism. The programme has been set up in such a manner that the students can achieve the objectives with regard to knowledge, attitude, understanding and skills. Hereinafter, we refer to these four attributes as 'final qualifications'.

On receipt of the degree certificate, the degree for the Mathematical Engineering programme will be awarded to the student.

#### Programme and profession

In the national classification, Mathematical Engineering - Data Science is included in the Applied Mathematics cluster. The programme combines mathematics with ICT and focuses on information delivery, analysis and management. Information and data play an ever increasing role in current society, resulting in a growing demand for engineers with mathematical knowledge and skills, able to derive accurate information from the filtering of data. It is important to combine appropriate mathematical applications with IT applications in order to achieve the required objectives. Solving practical problems in businesses and government institutions can benefit from a systematic and analytical approach, in which quantitative models and methods play an increasing role. There are many applications that increasingly rely on the use of mathematical techniques. The growth of information technology and its large-scale application leads to an increasing demand for mathematical expertise by businesses and other organisations. That is why the programme focuses on a combination of mathematics and algorithmics with software engineering. Graduates find work as all-round mathematical engineers working in jobs such as data scientist, data analyst, software engineer or IT consultant.

The national *beroepsprofiel Toegepaste Wiskunde* (Applied Mathematics Professional Profile) defines five focus areas, in which Mathematical Engineers play a relatively large role: actuarial science, data science, operations research, software development and statistics. In this context, Inholland's Mathematical Engineering programme is oriented toward Data Science and ICT related applications. This results in a focus on the areas 'data science (Big Data)', 'algorithmics & operations research' and 'software development'.

In its execution, the programme places great importance on leadership, collaboration and entrepreneurship, especially within projects. This focus creates a strong alignment between the programme and both the requirements of the regional professional environment and global developments in ICT.

#### Contents and orientation

The Mathematical Engineering-Data Science (ME) programme operates where mathematics meets ICT. Society is becoming more and more complex, particularly because of the growth of available information and the speed of changes. The industry is looking for people who can contribute to the management of increasingly complex work practices. Society requires mathematicians and ICT people who are broadly employable in multidisciplinary teams or able to cover a wide area independently. The programme is responsive to these developments – the contents and background of the programme have been laid down in the *Opleidingsprofiel* (Programme Profile). This profile is partly based on the national *Beroepsprofiel Toegepaste Wiskunde* (Applied Mathematics Professional Profile) and the national *Bachelor of Engineering* profile.

Graduates of Mathematical Engineering gain the title of Bachelor of Science.

#### Connection to industry and profession

The curriculum links to practice in various ways, enabling students to acquire relevant knowledge and skills. In the first place,

professional practice plays a role in the projects: various projects are real-world project cases, such as the project around Big Data commissioned by the company Basefarm and the development of an app in cooperation with external companies. Secondly, professional practice is brought 'home' by guest lecturers from the industry and by offering training in a real-life setting. The project teams in project-based learning also closely resemble real-world business project teams.

Finally both the third year internship and the graduation project take place at a business. Students also take part in the 'HBO-I Job Event'. Apart from the direct advantages to learning, contact with businesses offers students a perspective on the relevance of the offered curriculum and a chance to meet potential future employers.

## Chapter 2. Form and structure of the programme

### 6. Study load

The study load of a programme is expressed in credits. Each credit represents an average of 28 hours of study. These credits are equivalent to the European Credits (ECTS) used in European higher education institutions.

The study load is:

Bachelor's programme: 240 credits (foundation phase 60 credits, main phase 180 credits).

### 7. Foundation phase and main phase

The Bachelor's programme is divided into a foundation phase and a main phase.

In the foundation phase, students discover the content of the programme, the profession and what final qualifications are necessary for the programme. The purpose of the foundation phase is orientation, referral and selection. The foundation phase ends with the foundation examination. Students pass the foundation examination if they have completed all units of study of the foundation phase successfully. See also Article [9. Units of study](#).

The main phase follows after the foundation phase. The main phase ends with the final examination. Students pass the final examination if they have successfully completed all units of study in the main phase.

### 8. Joint foundation year

The programme does not have a joint foundation examination.

### 9. Units of study

The programme is divided into units of study. Each unit of study consists of educational activities that:

- aim to help students acquire knowledge, skills, understanding, attitudes and reflection;
- relate to each other and form one entity.

The study load of a unit of study is expressed in whole credits.

A unit of study may be further divided into modules.

A module is a part of a unit of study for which a test applies.

Students complete each unit of study with one or more tests. See also Articles [93. Oral tests](#) and [94. Other types of tests](#).

## Chapter 3. Basic curriculum, specialisation, main subject,

### 10. Basic curriculum

Every programme has a basic curriculum. This consists of the units of study that are mandatory for all students. In addition to the basic curriculum, students are presented with a range of additional optional subjects.

A Bachelor's programme can have specialisations or main subjects, or both. Programmes can also have different forms and variants.

### 11. Specialisation

The programme has no specialisation.

### 12. Main subject

The programme does not have main subjects.

### 13. Optional subjects

The programme Mathematical Engineering has the following optional subjects:

- Deep Learning 15EC
- Mobile Development 15EC
- GIS Fundamentals 15 EC

### 14. Form: full-time, part-time, dual

Programmes are offered in full-time form, in part-time form and/or in dual form.

- With a **full-time programme**, the teaching is arranged so that students spend 1,680 hours per year on their studies, spread over 42 weeks.
- A **part-time programme** is set up so that the studies can fit in with a job, in the evenings or for a few hours in the daytime. Sometimes requirements apply to the job. Students cannot follow a part-time programme if they do not meet these requirements.
- With a **dual programme**, students work during their studies, or during parts of their studies. Their work is part of the programme, the 'professional component'. Students get credits for this part, provided they get a good evaluation.

The structure of the curriculum and the content of the units of study may differ between the various forms. But the final qualifications (learning outcomes) that students ultimately achieve and the total study load are the same for all forms.

Mathematical Engineering only has a full-time variant.

### 15. Programme variants

Programmes can have different variants. The variants for the B Mathematical Engineering programme are:

The Mathematical Engineering programme does not have variants.

The structure of the curriculum and the content of the units of study may differ between the variants, but the final qualifications (learning outcomes) that students ultimately achieve are the same for all variants.

### 16. Honours programme

The programme does not offer an honours programme.

### 17. Additional programmes

The programme does not offer an additional programme.

### 18. Transition from Bachelor's to Master's programmes

Does the Bachelor's programme have a transition programme for moving on to its own Master's programme, or to a Master's associated with another programme or at another institution?

The Bachelor's programme does not have a transition programme for moving on to its own Master's programme, or to a Master's associated with another programme or at another institution.

### 19. Transition from Ad to Bachelor's programmes (not applicable to Bachelor's programme)

This Article is not applicable to the Bachelor's programme. The Ad programme has a separate TER.

## Chapter 4. Programme structure, content and evaluation

### 20. Terms and calendar

The academic year comprises four terms, each approximately ten weeks long. There may also be a fifth term, which then runs from mid-July to the end of August.

See attached overview of all the units of study of the 4 year programme.

### 21. Curriculum obsolescence and updating

The programme curriculum is updated regularly. The changes may be minor or major. Minor changes do not result in units of study or modules being renamed.

This year, there will not be any changes in the units of study or modules that would result in an expiry date or a new name of the unit of study or module.

### 22. Expiry dates of units of study and modules

Major changes result in the setting of an expiry date. The expiry date is the last date on which the unit of study or module, with the associated test(s), will form part of the programme curriculum.

If a module has an expiry date, the entire unit of study will expire on that date. Modules that are part of that unit of study but are not scheduled to expire will be incorporated into other units of study. The same applies to any test results or exemptions associated with the module. That other unit of study may be an existing unit of study or a new unit of study.

If a module is incorporated into another unit of study, a new weighting of its test will be set for the purpose of determining the final grade for that unit of study. See also Article [127. Grade for a unit of study](#).

In this academic year, there will not be any units of study with an expiry date in the programme.

### 23. Expiry date, transition period and validity period

The expiry date will be the last day of an academic year. We will announce the expiry date by no later than the first day of the next academic year. Depending on the timing of the announcement, a transition period may be added to the expiry date, by adding '+1 yr' or '+2 yrs'.

If students have already attended some of the classes for the unit of study that is going to expire, they are entitled to education based on the old programme as preparation for the associated tests, for the duration of the transition period. During that period, they are also entitled to sit the associated tests.

If they do not complete the entire unit of study within the transition period, they will have to attend the replacement classes instead, and sit the replacement tests.

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If an expiry date has an associated transition period, the tested knowledge, understanding or skills may be demonstrably obsolete. If this is the case, it will be stated under the module or unit of study in question.

Students who had already completed this component of the unit of study must bear in mind that their test results will have limited validity. See also Article [146. Limited validity period for tests and exemptions](#) and following.

If students do not succeed in completing the entire programme within the validity period applicable to them, they will have to attend the replacement classes instead, and sit the replacement tests.

### 24. Evaluation of the programme

The faculty works with two quality cycles whom both consist of four steps of Plan-Do-Act-Check (PDCA).

The 'small' quality cycle focuses on monitoring and improving the results per educational term or semester. (four or two times per academic year). After every term the teaching staff as well as the students discuss their analyses and points of improvement.

The 'large' quality cycle focuses on the integration of the different evaluations conducted in one academic year. It integrates the evaluations of the students, workfield, alumni and employees. and gives an overview of all these results.

## PART 4. ADMISSION

### Chapter 1. Admission to the foundation phase

#### 25. General rules of admission

The rules on admission to the foundation phase are set out in the [Rules on enrolment and deregistration](#) of Inholland University of Applied Sciences. This document can be found on the website and on Iris and is briefly discussed in Chapter 2 of this Education Guide. If prescribed by the WHW, these rules are included in the Rules on enrolment and deregistration. This applies at any rate to:

- the entrance examination;
- the examination for persons aged 21 years or older who do not meet the admission requirements (21+ examination);
- the prior education and entrance requirements for students who do not come from a country in the European Economic Area (EEA);
- the requirements for enrolling in a programme that will be partly or entirely taught in the English language.

#### 26. Admission following an interruption in enrolment

Students whose programme was interrupted by deregistration and who wish to re-enrol must ask the programme upon re-enrolment which results they have already achieved and to what extent these fit in with the programme as it applies at the time of re-enrolment.

The programme will let these students know in writing what additional classes and tests they must take to match up with the tests they have passed and which exemptions they have. The students must also comply with the other rules for enrolment and deregistration.

Enrolment for a programme that is being phased out is not possible.

#### 27. Admission to a part-time programme

The programme has no part-time form.

#### 28. Admission to a dual programme and work-study agreements

The programme has no dual form.

### Chapter 2. Admission to the main phase

#### 29. Admission to classes and tests in the main phase with a foundation certificate awarded by Inholland

To be admitted to the main phase, students need either a foundation certificate from the programme or a joint foundation phase exam that also applies to the programme. The faculty director may determine in this respect that a student will not be admitted to one or more specialisations or main subjects. More information is provided in Article [38. Exclusion from main subjects or specialisations](#).

Generally speaking, admission to the main phase means that students are admitted to all units of study and tests. However, for some units of study additional conditions apply before students can take classes or sit tests. Students must meet these conditions before they can take part in those units of study.

Careful thought has been given to the structure of the curriculum and the order of the units of study. However, students are not required to follow this order.

#### 30. Admission to the main phase with a foundation certificate awarded by another institution of higher professional education

If students have a foundation certificate from another institution of higher professional education, the Examination Board will

assess for which units of study they may be offered an exemption or whether they can start the main phase straight away.  
The Examination Board will make its decision within 30 working days after receiving a complete request.

### **31. Admission to main phase classes and tests without a foundation certificate**

If the student does not yet have a foundation certificate and has also not met the binding study recommendation standard, they can still attend the units of study in the main phase/the second year. If special conditions apply to participation in a unit of study, students can only attend the unit of study if they meet these conditions.

#### **31.a Entry and transfer requirements for units of study from the second year**

See articles 35 and 36.

## **Chapter 3. Switching**

### **32. Switching between forms and variants**

Switching between forms and variants within a programme is allowed. Students must comply with the conditions for admission and enrolment that apply to the form or variant to which they wish to switch.

The Examination Board will determine how students' test results and exemptions will be incorporated into the form or variant to which they are switching.

### **33. Switching between programmes with a joint foundation examination**

With a joint foundation exam, students are enrolled in one specific programme, and their results are recorded towards that programme.

If students switch to another programme with the same joint foundation exam before completing their foundation phase, they retain their results and exemptions from the foundation programme. These are transferred to the new programme, with the dates on which the results were achieved being maintained.

If students switch programmes after receiving a foundation certificate, no new foundation certificate will be awarded for the new programme.

Any warnings issued as part of the binding study recommendation remain applicable after a switch.

If students have received a binding study recommendation for one of the programmes with a joint foundation exam, they cannot switch to another programme with the same joint foundation exam.

### **34. Switching between Ad and Bachelor's programmes**

Students cannot switch from an Ad programme to the Bachelor's programme.

## **Chapter 4. Admission to work placements and graduation programmes**

### **35. Work placements**

Students require permission from the programme to be able to start a unit of study that includes a work placement component. Permission is granted through the signing of a placement contract by or on behalf of the faculty director.

If other conditions apply to participation in the unit of study, students must meet these as well before they can participate. The programme deals with these conditions with leniency.

Conditions apply before a student can go on Internship in year 3. The conditions apply to the assignment as well as the company of the internship. You can find the details in the Manual Internship Mathematical Engineering on Moodle.

More conditions and prerequisites apply for going on Internship. A student is allowed to start the Internship only when:

1. he/she has completed the foundation programme (year 1);
2. he/she has accumulated at least 100 EC of the first and second year.

If you want to go on Internship even though you do not meet all the conditions you can contact the Internship coordinator. In special circumstances you can submit a request with sufficient arguments to go on Internship. The Internship coordinator will discuss your request with the head of department and together they will make a decision.

If you do not agree with their decision you can submit a complaint to the Exam Board.

### 36. Graduation programmes

Students require permission from the programme to be able to take a unit of study that is part of a graduation programme. The graduation programme consists of units of study with one or more graduation products.

Conditions apply before a student can go on graduation programme in year 4 to write the final Thesis. The conditions apply to the assignment as well as the company of the Thesis. You can find the details in the Manual Graduation Project Mathematical Engineering on Moodle.

More conditions and prerequisites apply for going on graduation programme. A student is allowed to start the Internship only when:

1. he/she has completed the foundation programme (year 1);
2. he/she has completed the Internship successfully;
3. he/she has accumulated at least 190 EC in the programme.

If you want to go on Graduation Project even though you do not meet all the conditions you can contact the Graduation Project coordinator. In special circumstances you can submit a request with sufficient arguments to go on Graduation Project. The Graduation Project coordinator will discuss your request with the head of department and together they will make a decision.

If you do not agree with their decision you can submit a complaint to the Exam Board.

## Chapter 5. Admission to optional subjects, main subjects and specialisations

### 37. Optional subjects

Part of your studies at Mathematical Engineering at Inholland is doing electives or minors.

Some general rules apply for ME-students in order to be able to enroll. A student is allowed to participate in electives or minors only when:

1. he/she has completed the internship;
2. he/she has completed the foundation programme (year 1);
3. he/she has achieved at least 100 EC of the first and second year;
4. he/she qualifies for the chosen elective course or minor.

The programme Mathematical Engineering offers several minors in the third year a student can choose from:

1. Deep Learning - 15 EC;
2. GIS and Remote Sensing - 15 EC;
3. Mobile 15 EC.

You don't need extra permission by the Exam Board, there minors are already approved.

It is also possible to choose a minor at another programme of Inholland or at another University. If you choose to do so make sure you start the process of enrollment on time. You need to have approval from the team of Mathematical Engineering and approval of the Exam Board. this takes time, so start early. We expect minors to be at the level that can be expected of a year 3 student.

On Moodle you can find more information on the process of applying for outside electives or minors.

If you do not make a choice 4 weeks before the start of a minor you will be expected to join the minor that is on offer at that moment at Mathematical Engineering.

### 38. Exclusion from main subjects or specialisations

Students select a main subject and specialisation from the range offered by their programme. However, the faculty director may decide not to allow a student to take a main subject or specialisation, if differences in the nature and content of that main subject or specialisation justify such a decision.

In making the decision, the faculty director takes into consideration the study results, the programme as followed by the student, or both, and the relationship between these and the content of the main subject or specialisation.

### 39. Participation in more than one main subject or specialisation

If students wish to participate in more than one main subject or specialisation, they must indicate in advance to the Examination Board for which main subject or specialisation they wish to take the final examination. The choice for one particular graduation track is specified on the certificate. The other choice is extracurricular. This means that this choice is not part of the programme itself. Specialisations are not reported on the certificate. All units of study that the students have successfully completed will be included in the list of grades and the diploma supplement.

## Chapter 6. Admission to optional subjects

### 40. Optional subjects

Part of your studies at Mathematical Engineering at Inholland is doing electives or minors.

Some general rules apply for ME-students in order to be able to enroll. A student is allowed to participate in electives or minors only when:

1. he/she has completed the internship;
2. he/she has completed the foundation programme (year 1);
3. he/she has achieved at least 100 EC of the first and second year;
4. he/she qualifies for the chosen elective course or minor.

The programme Mathematical Engineering offers several minors in the third year a student can choose from:

1. Deep Learning - 15 EC;
2. GIS Fundamentals - 15 EC;
3. Mobile 15 EC.

You don't need extra permission by the Exam Board, there minors are already approved.

It is also possible to choose a minor at another programme of Inholland or at another University. If you choose to do so make sure you start the process of enrolment on time. You need to have approval from the team of Mathematical Engineering and approval of the Exam Board. this takes time, so start early. We expect minors to be at the level that can be expected of a year 3 student.

On Moodle you can find more information on the process of applying for outside electives or minors.

If you do not make a choice 4 weeks before the start of a minor you will be expected to join the minor that is on offer at that moment at Mathematical Engineering.

### 41. Optional subjects package

Optional subjects will be offered as a package because this is necessary to achieve the final qualifications (learning objectives) for the programme. The students are required to select the entire package.

The name of the package only appears on the list of grades and the diploma supplement, if students have completed the entire package.



#### 42. Exemption and substitution of optional subjects

Students can request an exemption from the Examination Board if they have taken certain tests as part of another programme. In this case, they must choose an optional subject first and then apply for an exemption. [Chapter 18. Exemptions](#), particularly Article [160. Exemptions procedure and evidence](#), contains more information about how students can apply for exemptions and the requirement that they must state the reasons why they need an exemption.

Students can also request the Examination Board to grant them permission to take other units of study that allow for national and international mobility. These are known as 'substitute units of study', as explained in Article [167. Request for substitution](#) and following Articles.

#### 43. Permission by the Examination Board for optional subjects

If students choose an optional subject that is not offered by their own programme, they must first discuss the choice with their study counsellor.

They must then submit a request to the Examination Board. In the request, they must indicate:

- how the choice aligns with the profile of their programme in terms of final qualifications (learning objectives) and level;
- how the choice relates to the phase of the programme in which they are making the choice;
- how the choice fits in with their personal goals.

The Examination Board will make a decision within fifteen working days.

#### 44. Changing a selected optional subject

Students can change their choice of optional subject at any time up until five weeks at the latest before the start of term. To do so, they must repeat the procedure set out in Articles [42. Exemption and substitution of optional subjects](#) and [43. Permission by the Examination Board for optional subjects](#).

#### 45. Extra optional subjects

Students can obtain extra credits by taking more optional subjects than provided for in the graduation programme. In this case, they must let the Examination Board know which units of study are extracurricular. These units of study do not form part of the final examination.

Students who choose to take extra optional subjects are recommended to take note of the provisions of Articles [175. Degree certificate](#) and [177. Deferral of awarding of the degree certificate](#) when deciding on the order in which to complete the optional subjects. These articles determine when a degree certificate will be awarded and when the awarding of the certificate will be postponed.

## PART 5. APPLYING FOR UNITS OF STUDY

### Chapter 1. Applying for units of study in the basic curriculum

#### 46. Applying for units of study

Students do not need to apply to take units of study in the basic curriculum. However, applications are sometimes necessary for the organisation of the programme, for instance in the case of field trips. Where an application is required, it will be stated in the unit of study description.

Students will be informed as quickly as possible as to whether they can take the units of study for which they have applied. They will receive this information at least two weeks before the unit of study is due to start.

If there are more applicants than places, students will be placed in the order in which they applied. Students for whom the unit of study is an integral part of their basic curriculum will be given preference ahead of students for whom this is not the case.

Students who cannot be placed will be offered an alternative option.

### Chapter 2. Applications and placement for optional subject

#### 47. Applying

Students must apply in good time to take optional subjects.

The information provided on optional subjects will specify how and when students can apply.

If a minimum number of students is necessary in order for an optional subject to go ahead, this will be announced in advance. Students will also be notified in advance if there is a cap on student numbers for an optional subject.

Students who were previously admitted to an optional subject but did not start it must apply again, stating 'previously admitted' as their reason.

#### 48. Placement

Students who apply for optional subjects in good time and according to the correct procedure will be placed in those optional subjects, unless there are too many or too few applications. For Study Abroad, other guidelines apply for the placement. For more information, check the student handbook Study Abroad, [31.a Entry and transfer requirements for units of study from the second year](#), [37. Optional subjects](#) or article [40. Optional subjects](#).

At least six weeks before the start of term, students will be notified whether they have been placed in their optional subjects. If they have not been given a place, they will be notified of the reasons for this, and also how and within what timeframe they can make a new choice.

Note: Placement alone is not always in itself sufficient for a student to be able to take a unit of study. If other conditions apply for participation in the unit of study, students must meet these too.

#### 49. Too few applications

If fewer than the minimum number of applications are received, the faculty director responsible for that optional subject may decide not to allow the unit of study to go ahead. In that case, the faculty director will offer the students who applied for the optional subject one or more alternative options. Where possible, this will include the option of taking the same or a similar optional subject at another location.

#### 50. Too many applications

If too many applications are received, students will be placed in the order in which they applied. Applications for optional subjects that are not extracurricular will be given priority. See also Article [45. Extra optional subjects](#). The faculty director will offer

students who are not given a place one or more alternative options. This may include the option of taking the same or a similar optional subject at another location.

For Study Abroad, other guidelines apply for the placement. For more information, check the student handbook Study Abroad, [31.a Entry and transfer requirements for units of study from the second year](#), [37. Optional subjects](#) or article [40. Optional subjects](#).

## PART 6. STUDY COUNSELLING

### Chapter 1. Study counselling

#### 51. Mandatory component of the programme for all students

Every student will receive study counselling and have a study counsellor.

Study counselling is a mandatory component of the programme. It is related to the student's academic phase. It is also possible to receive advice and counselling regarding personal circumstances – see the [Student Counsellor page](#) on Iris.

#### 52. Content of study counselling

At a minimum, study counselling includes:

- guidance on choices during students' studies;
- academic progress;
- inquiring after the consequences of the coronavirus measures;
- the study recommendation.

Students can view their own academic progress electronically.

At Mathematical Engineering we talk about Professional Skills instead of Study Coaching. It offers guidance in (study) career choices and promotes progress in learning. Individual progress discussions and group meetings are held every three months. In the first year Professional Skills focuses on study skills, study planning and what it takes to study at a University of Applied Sciences (HBO) in the Netherlands. Here, students are encouraged to be actively involved in their own learning process and development. During the study, the character of the guidance shifts from direction via coaching to self-direction.

For each year, a student has one fixed Professional Skills coach assigned (their PSC or *coach*). This coach guides the student toward an appropriate perspective on the programme and the labour market and supports him in implementing appropriate study planning. As a part of this, first-year students write a motivation letter to the programme.

In year 2 the focus is on study progress and in years 3 and 4 the student receives guidance in the preparation and execution of the internship and graduation.

### Chapter 2. Recording data as part of study counselling

#### 53. Recording data in study counselling

For each student, the study counsellor will record the agreements made during study counselling sessions. For disabled students, the study counsellor will also record the relevant agreements they have made. The same applies to agreements with students enrolled as elite athletes.

Students will be given a copy of these agreements on request. For disabled students, more information is given in Article [107. Disability](#) and for elite athletes in Article [66. Adjusted standards for elite athletes](#) and Chapter 2 of this Education Guide.

Students are entitled to view the information recorded about them.

# PART 7. STUDY RECOMMENDATION AND BINDING

## STUDY RECOMMENDATION

*For the time being, this part of the TER applies in full. It is possible that the developments in the coming months will give cause for adjusting the provisions related to the binding study recommendation. Such an adjustment will result in an addendum to this TER.*

### Chapter 1. Study recommendation

#### 54. Content of study recommendation

At the end of the first year of enrolment for the foundation phase of the programme (cohort 21-22), or at the end of the second year of enrolment for the foundation phase of the programme (cohort 20-21), students receive a written recommendation from the faculty director relating to the continuation of their studies within the programme or elsewhere. This recommendation is based on the test results recorded in the PeopleSoft academic monitoring system.

Where necessary, the recommendation will include a warning or a rejection. More information about warnings can be found in Article [77. Warning](#), and more information about rejections is contained in Articles [56. Quantitative academic performance standard](#) to 63.

The study recommendation applies to all forms and variants of the programme. If a student switches from one form or variant to another and the programmes are different, the faculty director will adjust the study recommendation after the switch if necessary.

#### 55. When study recommendations will be issued

Students from cohort 20-21 and from cohort 21-22 will receive their recommendation on or before 31 July 2022 at the latest.

Students who are part of the February intake from cohort 20-21 and from cohort 21-22 will receive their recommendation on or before 1 March 2023 at the latest. This recommendation relates to the first 24 months of study, i.e. up to and including 31 January.

Students who enrol on any date other than 1 September or 1 February will receive their study recommendations:

- on or before 31 July 2022 at the latest for cohort 20-21 and for cohort 21-22 if they joined the September intake;
- on or before 1 March 2023 at the latest for cohort 20-21 and for cohort 21-22 if they joined the February intake.

The standards for the study recommendation are set out in Article [67. Different standard for interim entrants](#).

### Chapter 2. Binding study recommendation in the first year of enrolment

#### 56. Quantitative academic performance standard

##### a. Level of the quantitative academic performance standard

At the end of the first year of enrolment in the programme, students must have obtained at least 45 of the 60 available credits in the foundation phase. When students have obtained at least 40 credits, of which 25 credits in period 3 and 4, the quantitative standard has been met. Please note: this is a pilot.

##### b. Quantitative academic performance standard where exemptions have been granted

If students have been granted exemptions from the tests for one or more units of study, the quantitative academic performance standard will be 84% (50/60) of the remaining number of credits in the foundation phase. This rule also applies to the accelerated curriculum for students with a pre-university education.

If the programme has a quantitative academic performance standard of less than 50 credits, the remaining number of credits will

be multiplied by  $n/60$ , where  $n$  is the number of credits in the standard.

NOTE: not applicable for Horticulture.

#### 57. Qualitative academic performance standard

The programme has one or more qualitative standards for the binding study recommendation. At the end of the first year students must have obtained all these units of study. The programme has the following qualitative standard(s) for the binding study recommendation:

- Precalculus
- English 1

#### 58. Issuing of binding study recommendation

Students must have complied with the quantitative academic performance standard by the end of the first year of enrolment. If the programme has set a qualitative academic performance standard, students must also comply with that standard. If students do not comply with the standards, the students will receive a written rejection. This is known as a binding study recommendation.

In the case of a joint foundation exam, the binding study recommendation applies to all programmes with the same foundation exam.

#### 59. Binding study recommendation and personal circumstances

The faculty director will not issue binding study recommendations where students have not been able to comply with the standards for binding study recommendations due to personal circumstances. The procedure for providing evidence of personal circumstances is set out in Articles [82. Personal circumstances](#) and [85. Definition of personal circumstances](#).

If the programme has set a qualitative academic performance standard and the student has not achieved that standard, and if the personal circumstances which prevented the student from achieving the quantitative academic performance standard did not present an obstacle to meeting the qualitative standard, the faculty director will always issue a negative binding study recommendation.

#### 60. Binding study recommendation and switching out of the accelerated variant

This article does not apply voor the programme B Mathematical Engineering.

## Chapter 3. Binding study recommendation after the first year of enrolment

#### 61. Standard for a binding study recommendation after the first year

If a student did not meet the minimum academic performance standard (quantitative and qualitative, where applicable) at the end of the first year, and the faculty director was not able to issue a binding study recommendation, the student must successfully complete the full first-year curriculum during, or by the end of, the second year of enrolment or the time limit set.

This applies to students:

- to whom a binding study recommendation could not be issued because of personal circumstances;
- to whom in the academic year 2020-2021, as a result of the coronavirus measures, postponement was given until 31 July 2022 (1 March 2023 for the February entrants) for achieving the minimum standard;
- who did not receive a binding study recommendation because their enrolment was interrupted. See also Article [69. Binding study recommendation following an interruption in enrolment](#);
- who were too many credits short of the standard for the first time at the end of the fourth term, at which time the deficit was discovered. See also Article [77. Warning](#);
- whose test results for the programme after the first year clearly indicated suitability of the student. See also Article [62. When a binding study recommendation will be issued after the first year](#).

#### 62. When a binding study recommendation will be issued after the first year

The faculty director will issue a binding study recommendation upon determination that the student cannot successfully complete

the remainder of the first-year programme within the timeframe granted to the student.

The faculty director will not give a negative binding study recommendation if there are personal circumstances; see also Article [82. Personal circumstances](#). It is necessary that the student counsellor issues advice.

The faculty director will give a positive recommendation if the test results for the programme after the first year clearly indicate the student's suitability.

### 63. Extending the timeframe

It is possible that, due to personal circumstances, a student may not receive a binding study recommendation during or at the end of the second year of enrolment but will instead receive a warning stating a timeframe. If it subsequently becomes apparent that the student is unable to meet the standard within that timeframe, the faculty director will issue a binding study recommendation at the end of the timeframe specified in the letter. If relevant personal circumstances still exist, the faculty director will again take the severity of these circumstances into account. See also Article [82. Personal circumstances](#).

## Chapter 4. Consequences of a binding study recommendation and when enrolment will end

### 64. Termination of enrolment

Students who have received a binding study recommendation from Inholland may not continue with the programme. Their enrolment will be terminated.

### 65. When the enrolment will end

If a binding study recommendation is issued after 1 June, the enrolment will end on 31 August.

If a binding study recommendation is issued earlier in the academic year, the enrolment will be terminated at the time immediately after the end of the last day of the month in which the binding study recommendation was issued. If there are only a few days remaining between the issuing of the recommendation and the last day of the month, the student's enrolment will be terminated one month later.

## Chapter 5. Special cases and binding study recommendation

### 66. Adjusted standards for elite athletes

An elite athlete is a student who meets the conditions set out in the Profile Fund Regulations. These regulations can be found in this Education Guide in Chapter 3.3.

In addition to the provisions of Article [85 h](#), the faculty director may make an agreement with an elite athlete setting adjusted standards for the first year of enrolment. This will be done as soon as possible after enrolment. The faculty director will send the student a letter setting out the agreements. The faculty director may appoint someone else to make the agreements and send them to the student.

### 67. Different standard for interim entrants

#### Quantitative academic performance standard

The faculty director will determine which credits the student will be unable to achieve upon entering in the interim, in light of the scheduling of the classes and tests. This number will be deducted from the first-year study load. (The first-year study load is 60 credits for the regular programme and 45 for the accelerated variant.) The student must achieve 84% of the difference in the first year of enrolment. This number will be rounded up.

If the student has exemptions, the percentage will be applied on the total number of credits minus the number of credits for the

units of study for which the student has exemptions, and minus the number of credits that the student will be unable to achieve due to the scheduling of classes and tests. This number will be rounded up as well.

#### **Qualitative academic performance standard**

If there is a qualitative academic performance standard, the number of credits for the units of study that form part of the standard and that the student cannot achieve due to entering in the interim will be deducted from that standard.

Soon after the intake, the faculty director will determine what the quantitative and qualitative academic performance standards will be. The faculty director will consult the student first, and then send the student a letter setting out the standards.

#### **68. Binding study recommendation and switching to another programme**

If students switch to another Bachelor's programme or Ad programme, the rules of the binding study recommendation will again apply to the new programme.

**Important note:** After receiving a binding study recommendation, students cannot switch to a programme with the same foundation exam. It is also not possible, after having received a binding study recommendation, to switch from an Ad programme to a Bachelor's programme (or vice versa) with the same foundation exam. The standards for binding study recommendations are set out in Article [56. Quantitative academic performance standard](#) and [57. Qualitative academic performance standard](#).

After receiving a binding study recommendation, students cannot transfer credits that they obtained in the old programme to the new programme. However, they can apply to the Examination Board for an exemption from tests if they meet the applicable conditions. See also Articles [155. Exemptions from tests](#) to [162. Waiving further investigation](#).

#### **69. Binding study recommendation following an interruption in enrolment**

Students who are deregistered less than two months after enrolment and re-enrol in the same programme in a subsequent academic year will be subject to the same rules around warnings and binding study recommendations as students enrolling in the programme for the first time.

If a student from the September intake terminates their enrolment before receiving a binding study recommendation and then re-enrols in a subsequent academic year, the binding study recommendation standard entails that they must pass the foundation examination in that year. When they enrol, the student will receive a warning notifying them of this fact.

If a student from the February intake terminates their enrolment before September of that year and then re-enrols in the same programme on 1 September, generally speaking the same rules will remain applicable to them regarding warnings and binding study recommendations. The quantitative academic performance standard may be adjusted in individual cases. If this is the case, it will be stated in the warning that the student receives at the time of re-enrolment.

If a student deregisters before the end of the academic year, and they could not have met the BSA standard anymore even if they hadn't deregistered, and if there are no personal circumstances as referred to in Article [85. Definition of personal circumstances](#), then a binding study recommendation will be issued.

The rules in this Article also apply if a student re-enrols for a programme with the same foundation exam as the programme in which they were previously enrolled.

## **Chapter 6. Academic progress and international students**

#### **70. Students to whom these rules apply**

The rules in the following Articles (up to and including Article 75) concerning academic progress apply to students who:

1. do not come from a member state of the [EEA](#) or from Switzerland (these are students who require a residency permit); and
2. are covered by the 'Code of Conduct for International Students in Dutch Higher Education'.

These rules are in addition to:

- the rules on academic progress, study recommendations and binding study recommendations in this TER; and
- the academic progress requirements for students who receive a knowledge grant from the university under the Profile Fund Regulations.



### 71. Criteria

According to the Code of Conduct, students have made satisfactory academic progress if, in each academic year, they have achieved:

- at least 15 credits by participating in tests in the first two terms;
- at least 30 credits over the entire academic year.

### 72. Procedure at the end of Term 2 and Term 4

The faculty director determines students' academic progress twice each year:

- at the end of Term 2;
- and at the end of Term 4.

If a student is deemed to have made unsatisfactory academic progress after Term 2 and at the end of the academic year, their study counsellor will discuss this with them. If there are any special circumstances as referred to in Article [86. Other special circumstances](#), the study counsellor will make a reasonable agreement with the student to ensure that their academic progress is restored to the required level as quickly as possible. The student is required to comply with this agreement.

### 73. Procedure at the end of the academic year

If at the end of the academic year the faculty director finds that a student is no longer attending any classes at all, or their abilities are insufficient for the level of the programme, the university will report the student to the Immigration and Naturalisation Service (IND) within one month. The 'end of the academic year' is always the end of July/August, even for students from the February intake. If a student is failing to meet the progress standard that applies to them, this will be sufficient reason for determining that their abilities are insufficient for the level of the programme. This does not apply if the study counsellor has made an agreement with the student as described in Article [72](#). The faculty director will inform the student in a letter of his decision regarding the special circumstances relating to their failure to meet the required standard. This letter will include the faculty director's reasons, as well as information on how the student can appeal against the decision.

### 74. The university will refrain only once from reporting a student

Where the same set of special circumstances is involved, reporting an international student to the IND for unsatisfactory academic progress can be refrained from only once during the entire period in which the international student is enrolled at the university. The Central Student Administration makes the report on behalf of the faculty director.

### 75. Records

The faculty director makes a record of:

- the unsatisfactory academic progress;
- the personal circumstances; and
- the fact that no report was made.

## Chapter 7. Procedure for issuing binding study recommendations

### 76. No binding study recommendations without prior warning

The faculty director must first give the student a written warning before issuing a binding study recommendation.

### 77. Warning

If a student's academic progress has been unsatisfactory during their first or second year of enrolment (in the event of postponement of the study recommendation related to coronavirus measures) in the foundation phase, and as a consequence they are in danger of receiving a binding study recommendation, the student will receive a warning from the faculty director. The warning will be given in writing.

### 78. When the warning will be sent

The faculty director sends the warning in the first year (or second year in the event of postponement of the study recommendation related to coronavirus measures) during the term in which the students' poor academic progress is first noted, or

as soon as possible after the end of that term.

If the faculty director only notices students' poor academic progress in Term 4, and is unable to issue a warning due to the results at the end of that term, the students will receive a warning that they must successfully complete the full first-year curriculum in the second year of enrolment. The warning will form part of the study recommendation.

If a student cannot meet the standard for avoiding a binding study recommendation due to personal circumstances, they will receive a warning that the foundation phase must be successfully completed during or by the end of the second year. The warning will form part of the study recommendation.

#### **79. Content of the warning**

The warning will indicate the total number of credits that the student must obtain. The warning will also indicate the date by which the student must have obtained these credits.

The terms in which classes for the units of study in question will be run, and the timing of the tests, are taken into account upon setting this date. The rule is that there should be two test opportunities per academic year, unless one of the exceptions in Article [96. Number of test opportunities per academic year](#) applies.

If the student is subsequently given a new deadline due to personal circumstances, this applies only to the first test opportunity for the remaining units of study.

#### **80. Scope of the warning**

The warning applies to all forms and variants of the programme.

In the case of a joint foundation exam, the warning applies to all programmes with the same foundation exam.

If the programme is run in multiple locations, the warning applies to all locations.

However, if students switch from one form, variant or location to another, and the curriculum is different, the warning may be adjusted if necessary. If such an adjustment is made during the first year of enrolment, only the standard will be adjusted.

#### **81. Warning in the case of re-enrolment following deregistration**

If a student does not receive a warning because they have already deregistered, and if they re-enrol in the same programme, or in a programme with the same foundation examination, they will receive the warning as soon as possible after re-enrolment.

The standards for a 'Binding study recommendation following an interruption in enrolment', as described in Article [69. Binding study recommendation following an interruption in enrolment](#), will apply to the warning.

#### **82. Personal circumstances**

Students may fall behind in their studies due to personal circumstances. Article 85 outlines what those personal circumstances might be. The faculty director takes any personal circumstances into account when deciding whether to issue a binding study recommendation. The faculty director can only do this if he or she is aware of the personal circumstances. Accordingly, students must report personal circumstances to the student counsellor. The faculty director will always seek advice from the student counselling service before issuing a binding study recommendation. The student counsellor will provide written advice. In the advice, the student counsellor will address:

- whether the student has reported personal circumstances as defined in article [85. Definition of personal circumstances](#);
- if so, whether the student has delivered proof of the personal circumstances;
- whether the student counsellor can establish a connection between the personal circumstances and the study credit deficit of the student;
- if possible, for how many study credits the student has fallen behind due to the personal circumstances and/or which period or courses the deficit relates to.

The student counsellor will send the advice to the faculty director and to the student. The faculty director will also consult the study counsellor about students' academic progress and its connection to their personal circumstances.

#### **83. Meeting**

Before a binding study recommendation is issued, students will be offered the opportunity to explain their side of the story to the

faculty director or to someone else assigned to meet with students on behalf of the faculty director. Among other things, this meeting will include a discussion of whether the overview of academic results achieved is accurate. The participants of the meeting will also look at whether the personal circumstances should be taken into account.

If a student fails to take up an invitation to attend such a meeting, this will be noted in their student file.

## Chapter 8 Request for lifting a binding study recommendation

### 84. Lifting

Students who have received a binding study recommendation may submit a request to the faculty director to review the rejection.

Such review by the faculty director can take place no earlier than twelve months after the date on which the enrolment was terminated due to the binding study recommendation. In their request, students must provide plausible arguments to show that they will now be capable of successfully completing the programme. These arguments can be based by the students on activities, which may include studies, that the students have engaged in since leaving the programme.

The faculty director will not review the rejection if the programme is being phased out or has been discontinued.

## Chapter 9. Special and personal circumstances and academic progress

### 85. Definition of personal circumstances

The personal circumstances that can play a role in the decision of whether to issue a binding study recommendation as described in Article [82. Personal circumstances](#) are:

- a. student illness;
- b. physical, sensory or other disabilities;
- c. pregnancy of the student;
- d. special family circumstances;
- e. membership of a representative advisory council, faculty representative advisory council, student committee or programme committee at the university;
- f. membership of an accreditation committee, as specified in Chapter 5a of the WHW;
- g. membership of the board of a student organisation or other administrative activity, as explained in Article 2(3) of the Profile Fund Regulations, which can be found in the Education Guide;
- h. competing as an elite athlete (see also Article [66. Adjusted standards for elite athletes](#));
- i. personal circumstances not listed in (a) to (h) above, which, if the board of the university did not take them into consideration, would lead to a significant and unfair disadvantage.

### 86. Other special circumstances

In addition, the following provisions concerning the academic progress of international students (Articles [70. Students to whom these rules apply](#) to [75. Records](#)) and the validity period of results (Articles [146. Limited validity period for tests and exemptions](#) to [148. End of validity period](#)) apply:

1. a programme cannot be completed within the nominal time;
2. activities in the social sphere.

Students may also fall behind in their studies in a way that makes them eligible for financial assistance under one of the student financial support schemes as outlined in Chapter 3 of this Education Guide.

### 87. Procedure for establishing special and personal circumstances

- a. *Notify the student counsellor as soon as possible*

If any of the circumstances set out in Articles [85. Definition of personal circumstances](#) or [68. Binding study recommendation and switching to another programme](#) arise and cause a student to fall behind with their studies, they should notify the student counsellor as soon as possible, stating:

- the period of time for which the circumstances applied or will apply;
- what the circumstances are and how serious they are;
- the student must provide evidence; the extent to which the student was or will be unable to participate in classes or tests.

All contacts with students are recorded in the student counselling information system. If students so wish, they can obtain a copy of everything recorded in the system about these contacts.

#### *b. Student Counsellor's Declaration*

The student counsellor will draw up a 'Student Counsellor's Declaration' if:

- a student has proven that personal or special circumstances are applicable; and
- the student counsellor has determined that the student has fallen behind or is likely to fall behind in their studies due to these circumstances.

This declaration will specify the date of the first meeting about the circumstances and all matters listed under (a) above. The student counsellor may also include comments, advice and arrangements for the student or for discussion with the study counsellor.

Some circumstances are confidential. If so, the student counsellor will discuss with the student what will be included in the declaration.

#### *c. Discussion with study counsellor and adjustment to study plan*

The student will show the Student Counsellor's Declaration to their study counsellor and discuss with the study counsellor the inability to keep up with their studies and any advice they have been given. The student will then adjust their study plan. The discussion and adjustment to the study plan will take place as soon as possible after the meeting with the student counsellor.

If the student involved is an international student, the study counsellor will also talk about the IND's progress requirements. See also Article [73. Procedure at the end of the academic year](#).

#### *d. Request for special arrangement*

Based on special circumstances, a student in possession of a Student Counsellor's Declaration or advice from the student counsellor, may request special arrangements at the Examination Board, the programme or the service organisation.

### **88. Confidentiality of personal circumstances**

Everyone who is aware of a notification of personal circumstances:

- will handle the information in a confidential manner; and
- will use the information only as part of their duties and for the purpose of implementing the regulations in the Education Guide.

The student counsellor complies with the code of conduct for student counsellors and will give information to the programme only:

- within the scope of the student counsellor's role;
- within the parameters of the agreements the student counsellor made with the student about the confidentiality of the information.

## PART 8. TESTS

### Chapter 1. Content and administration of tests and publication of test standards

#### 89. Connection to unit of study

The final qualifications or learning outcomes and the goals for each test are connected to the unit of study described in Moodle courses of Mathematical Engineering, or to a module within that unit of study.

The project task or test questions will clearly and precisely state how students are expected to answer them.

#### 90. Test duration

Students will be given sufficient time to complete the test, according to reasonable benchmarks.

#### 91. Test standards

Test standards for practical work and group assignments are published prior to commencement of these assignments.

The test standards are published prior to publishing the test results.

### Chapter 2. Types of tests

#### 92. Types of tests

[Appendix: Annual Programmes](#) of the TER specifies the types of tests. There are three types of tests, which can be detailed in various ways:

1. Written  
Students answer test questions on paper or electronically, or they complete projects on paper or electronically.
2. Oral  
Students answer test questions in a meeting (online or physical) with one or more examiner(s).
3. Other  
For the test or project, students perform tasks that will be described clearly by the programme. Possibly a written, digital or oral component, or a combination of these, must also be completed.

If necessary, the type of test can be changed during the academic year, with due regard to the participation in the decision-making process. Students will be informed of this in a timely manner.

#### 93. Oral tests

##### a. One student examined orally at a time.

In an oral test (online or physical), one student is examined at a time, unless the Examination Board decides otherwise or if testing is conducted in a different manner. If so, this will be announced before the start of the unit of study.

##### b. Examiners and public access

Oral tests are conducted by two examiners. This may not be the case if it is not feasible from an organisational point of view, or if the test is administered online. In that case, the oral test must be recorded.

This will not be the case for the parts of a degree programme. These will be administered by two examiners. An oral test is open to the public, because that ensures transparency and allows for monitoring of the conduct of the test. This does not apply if the Examination Board decides otherwise.

### c. Rules for conducting tests

Oral tests are conducted by two internal examiners, or by one internal and one external examiner. An external examiner is an independent expert from the professional field.

If an oral test (online or physical) is conducted by a single examiner, an audio or video recording is always made.

### d. Protocol

For every oral test, a protocol will be drawn up. The examiners will sign the protocol. If an external examiner was involved in the test, he or she will also sign the protocol. The protocol will be preserved as specified in the university's regulations on retention periods.

If an audio recording of an oral test is made, it will be preserved as specified in the university's regulations on retention periods.

## 94. Other types of tests

### Grounds

Disabled students can ask the Examination Board if they can complete tests in a way that accommodates their disability as much as possible. They can also request any additional or adapted materials they may need to be able to complete the test.

Students can also ask to complete tests in another form for other reasons. The Examination Board will only grant such requests in exceptional, individual cases.

Adjustments are possible only if they do not change the test goals or the level of the test.

### Procedure

Students must request an alternative form of test by the start of term at the latest. They should submit their requests in writing to the Examination Board. The letter should set out the reasons for the request and enclose a copy of the advice received from the student counsellor ([Click here](#) for more information about advice from the student counsellor).

The Examination Board will make a decision as soon as possible, at any rate no later than fifteen working days after receiving the complete request.

## Chapter 3. Timing and frequency of tests

### 95. Timing of tests

Each unit of study will, if possible, end with one or more tests in the term in which the teaching was delivered. If the teaching was delivered over a whole semester, the test will, if possible, take place in that semester.

If a unit of study is composed of modules, the modules will likewise be completed, if possible, within the term or semester in which the unit of study was delivered.

The year programme states when the tests take place.

### 96. Number of test opportunities per academic year

For all tests of the programme in the form or variant as followed by the student, they will have two test opportunities per academic year, within normal term time. There are four exceptions to this rule. If there is an exemption, this will be set out in Schedule 1 of this TER.

- There may be only one test opportunity per academic year for tests *after the first year*, for which no resit can be scheduled in the same academic year due to the nature of the study unit. This applies, for example, to work placements in the fourth term.
- For some tests, the programme may indicate that students will be given more than two opportunities to complete them.
- The programme may also indicate that it will offer only one test opportunity in each academic year.

- It can be the case that offering two test opportunities per academic year is not feasible for all tests as a result of the coronavirus measures. If, due to these measures, it is not possible to offer two opportunities to take a test to the student in the current academic year, the opportunity/opportunities that has/have not been offered will be offered in the next academic year.

There are no exceptions on the number of test opportunities.

## Chapter 4. Resits

### 97. Timing of resits

The final resit opportunity in the first year will be scheduled before the end of Term 4. This is due to the fact that study recommendations need to be issued in time.

For tests which form part of the curriculum from the second year onwards (see the proviso in Part 7), resits can also be scheduled before the start of the new academic year. in other words, in Term 5.

### 98. Resit when test passed at first opportunity

Students who have passed a test are not entitled to a resit.

However, a student may want to resit a test in an exceptional situation. In this case, they must submit a request to the Examination Board, which will make a decision within thirty working days. If the Examination Board grants the request, the highest result that the student achieves will apply.

### 99. Additional opportunity due to special circumstances

In exceptional cases, the Examination Board may decide to provide an additional test opportunity.

This will only occur if personal circumstances exist as described in Article [85. Definition of personal circumstances](#), or in other extremely exceptional cases.

Students must submit a request to the Examination Board and state the reasons for their request. The Examination Board will seek advice from the student counsellor, if the Board deems this to be necessary. The Examination Board will make a decision within fifteen working days.

From 4 July 2022 onwards, there will be no additional opportunities in the first-year curriculum (see the proviso in Part 7). This is due to the fact that study recommendations need to be issued in time.

### 100. Resits in the context of curriculum obsolescence and updating

Special rules apply to resits if a curriculum is obsolete or being updated. See Articles [21. Curriculum obsolescence and updating](#) to [24. Evaluation of the programme](#).

## Chapter 5. Bringing forward test opportunities

### 101. Bringing forward

An Examination Board may permit a student, on a one-off basis, to take one or more tests earlier, so that the student can pass the final examination without a disproportionate delay.

This is subject to the condition that bringing forward the test opportunity is reasonably possible.

If both test opportunities in the academic year have already passed, the student will be given a third test opportunity. The student must submit a request to the Examination Board and state the reasons for the request.

The Examination Board will make its decision within fifteen working days after receiving the complete request. The Examination Board deals with these requests with leniency.

### 102. Conditions for bringing forward test opportunities

For a test opportunity to be brought forward, the student must meet the following conditions:

1. They must have a maximum of 10 credits left to obtain for a 240 credits programme, or a maximum of 7 credits for a 180 credits programme before completing the final examination.
2. For the obtaining of the remaining credits, the student is not subject to any attendance requirement for classes, nor is there any obligation to execute group projects.
3. The student cannot attend any classes or complete any tests in the next term or terms, due to the university's timetabling. This is based on the four ordinary terms of the academic year.
4. The student has:
  - attended the classes associated with the tests;
  - taken the tests concerned; and
  - tried to pass the tests with adequate preparation.

If the student has obtained at least 200 credits, without the graduation programme (Thesis), it is also possible in the programme to invoke this provision. The student can submit a request to that effect to the Examination Board.

## Chapter 6. Time, place and duration of tests

### 103. Test timetable, testing room, materials

In the first two weeks of each term, the Service Point will publish the **test timetable** that the programme has set on Iris. If there are any changes to **testing rooms**, these will be announced at least two working days before the test date.

The programme arranges test dates so that they are spaced in an optimal way for students. The period of time in which a written or oral test is taken is called a **test session**.

In the first two weeks of term, the examiner will publish a list of the **materials** that students may use in the test.

Students must also comply with:

- the rules concerning materials set out for the unit of study;
- the provisions regarding these rules in the test session instructions; and
- the instructions given by the Examination Board.

### 104. Deadline for submitting work

The test timetable will state the deadline for submitting work by the student other than in a test session. If this date is not stated in the test timetable, it will be announced in good time in another manner.

It will also be announced in advance what the consequences are if students do not submit work or do not submit it in a timely manner. This does not apply if this information is already included in Course on Moodle.

### 105. Length of the test session

#### Written test

A written test session lasts a maximum of 180 minutes, unless the Examination Board has set a longer timeframe for a particular student.

#### Oral test

An individual oral test session will last a minimum of 15 and a maximum of 60 minutes. This does not apply if the nature of the test session makes a longer timeframe necessary. Course on Moodle indicates the length of each test session. If necessary, it also states the reason for the length of a particular test session.



## Chapter 7. Special test arrangements

### 106. Language deficiency

If a student can prove that they are receiving additional instruction in the Dutch language at a suitable level for the purpose of participating in their programme, the Examination Board may grant an arrangement to the student. The student must submit a request for this to the Examination Board, providing evidence that the student follows a programme at the appropriate level. This applies in any case for students admitted on the basis of the Dutch as a Second Language (NT2) diploma, Programme II or another diploma at the same level. This programme should train the student in such a way that it enables the student to achieve level 4F at the end of the programme. The Examinations Board may extend the test session by up to thirty minutes. In addition, students may also be permitted to use a dictionary. This arrangement will be granted for a maximum of two years.

### 107. Disability

The Examination Board may decide to extend a test session for students with a disability by up to 60 minutes. They may also offer students additional auxiliary materials, or they may do both. Students must personally submit a request to this effect. More information about the student counsellor can be found [here](#).

### 108. Alternative test time or location

In very exceptional circumstances, the Examination Board may allow students to sit a test at another time or in another location. A disability is an example of exceptional circumstances.

### 109. Submitting a request for special arrangements

Students must submit their requests for special arrangements in writing to the Examination Board at the start of term. If the exceptional situation does not arise until later, students must submit their request as soon as possible after the situation arises. Ideally, the Examination Board would then put the special arrangements in place for the current term. If that is not possible because a student has submitted their request too late, the Examination Board will put the special arrangements in place for the next term.

In their letters, students must explain the reasons for their request.

If a student has a disability, they must include an electronic or written opinion from the student counsellor. If the student counsellor has accepted a statement from an external expert, the student counsellor must state this in the opinion.

The Examination Board will inform students of its decision in writing at the latest within fifteen working days after the submission of a complete request.

## Chapter 8. Registering for tests

### 110. Which tests to register for

Students must register for tests each term within the designated registration period. Registration is necessary for:

- written test sessions; and
- tests for which students must submit work that will be submitted and assessed via the digital environment.

### 111. What happens if students do not register in time

Students who fail to register in time can still register at the Service Point in the week following the registration period. They will then be entered through the Service Point.

Without registration, students cannot participate. If students failed to register due to circumstances beyond their control, they must submit a request to the Examination Board as soon as possible, seeking permission to participate. Such requests must be in writing and must explain the reasons for the request.

The Examination Board will inform students of its decision in writing at the latest within fifteen working days after the submission of a complete request.

#### **112. Identical tests**

If students are enrolled for more than one programme at the university, and these programmes offer the same test, the registration will apply to both programmes. However, there will still be only two test opportunities per year. The result will be recorded under both programmes.

#### **113. Confirmation of registration**

Students will receive confirmation of registration. Such confirmation does not always mean that students may participate. They may participate only if they meet all of the conditions for taking part in the test. These include both the general conditions in this TER and the conditions set out in Course on Moodle.

## **Chapter 9. Participation and attendance requirement**

#### **114. Participation in group work**

Students are required to actively participate in group work.

If a lecturer notices that a student is not cooperating and does not see any improvement despite urging the student to cooperate, the lecturer may tell the student that they can no longer participate in the unit of study or module. The lecturer must then report the student to the Examination Board as soon as possible. The Examination Board will make an official decision about whether the student may continue to take part in the unit of study or module.

Before the Examination Board makes its decision, it will give the student an opportunity to tell their side of the story. A report of this meeting will be drawn up.

If the teaching group, tutorial group or lecturer in question has not made sufficient effort to ensure that the student cooperates, the Examination Board can decide that the student may continue to participate. The Examination Board will make a decision within thirty working days.

#### **115. Attendance, active participation and/or preparation requirements**

If it is a requirement for a unit of study that students be present, actively participate and prepare in advance, the Examination Board may decide, on a proposal from the lecturer concerned, that a student may no longer participate. This may happen only if this is included in the description for the unit of study in the Course on Moodle.

Before the Examination Board makes its decision, it will give the student an opportunity to tell their side of the story. A report of this meeting will be drawn up.

In exceptional cases, the Examination Board may determine that students are not required to be present for all or for certain classes or are not required to prepare all or part of the work. If so, it will set substitute requirements for these students. In such cases, students must submit a request to the Examination Board, which will make a decision within thirty working days.

#### **116. Consequences of a decision to exclude**

A decision by the Examination Board to exclude a student will prevent the student from participating in the next test for the unit of study in question, unless a different penalty is specified in the unit of study description.

## **Chapter 10. Assessment**

#### **117. Examiner(s)**

Every test will be graded by one or more examiners. The Examination Board determines who the examiners will be.

If a test is graded by more than one examiner, the Examination Board will designate one to be the primarily responsible examiner. The primarily responsible examiner consults with the other examiner(s) to decide on the grades and associated feedback. The primarily responsible examiner then communicates the grades and feedback to the students. This is always the case when grading units of study that are part of a graduation programme or of a component of a graduation programme.

### 118. Grading procedure

The examiner grades the work against the test standards published in writing prior to the test. The Examination Board can change test standards or allow them to be changed. This may be done only in exceptional cases and only if the Examination Board explains why it is making the change.

Students have passed a test if the examiner determines that their written or oral work meets the requirements.

### 119. Grading transparency

Students must be able to see from the test standards and the grading procedure how their results were determined.

### 120. Assessing work placements and graduation products

The procedure for assessing work placements and the graduation programme parts will be documented in writing in a test protocol, together with the associated test forms.

Assessment of a unit of study that is part of a graduation programme or of a component thereof will be done by at least two examiners, unless the Course on Moodle states otherwise. The Examination Board may appoint an internal supervisor as an examiner, but not as the primarily responsible examiner.

The examiner, or where there are multiple examiners, the primarily responsible examiner, is responsible for the final grade awarded for the work placement and for the unit of study that is part of the graduation programme or a part thereof.

When assessing the work, the opinion of an external supervisor serves as advice to the examiner.

### 121. Assessing the vocational component of dual-form programmes and work placements

For dual-form programmes, the test protocol is appended to the work-study agreement so that the vocational component can be assessed. For work placements, the test protocol is appended to the work placement contract. The appendix contains the feedback and the opinion of the trainee supervisor on the student's performance. The trainee supervisor signs this document and sends it to the examiner.

The opinion of the trainee supervisor serves as guidance for the examiner who is responsible for the test.

## Chapter 11. Grades and grading scales

### 122. Grading in points

Tests are graded on a grading scale from 10–100.

Students have passed if they obtain a grade of 55 points or more.

If the grade is less than 10 points, it will be recorded as a grade of 10.

### 123. Pass/fail grading of tests

For reasons relating to programme content, a test may be given a grade of either 'Pass' or 'Fail'.

### 124. Submitting a blank test paper

If students submit a blank test paper, they will receive a grade of 10, or an F (Fail) in the case of a unit of study or module in which no grades are awarded.

### 125. Failure to participate in a test opportunity

If students do not participate in a test opportunity that applies to them, no result will be recorded in the academic monitoring system; however, they are considered to have used the test opportunity.

The same applies if students fail to register or cancel their registration.

Deregistering for a test by students is appreciated because it is helpful for organisational reasons to know who will be participating. But if a student doesn't register, this will have no effect on the number of test opportunities remaining to them.

### 126. Converting grades obtained at other universities

If a grade from another university is expressed using a different scale from the one applied by Inholland, the grade will be converted to one based on the scale from 10–100. The Examination Board will make rules for this procedure and appoint an examiner to convert the grade.

If the grade is obtained at an international university, a Pass (V) or Fail (O) will be listed instead of a grade. When a student is eligible for a designation as described in article [181. 'With merit'](#) or [182. 'Cum laude'](#) or when they need a certain average grade for further education, the student can request the Examination Board to convert the result from the international university into a grade.

The Examination Board will make a decision within fifteen working days.

### 127. Grade for a unit of study

The grade for a unit of study is the weighted average of the grades for the modules and tests in the unit of study, based on the ratio of the weights of the modules and tests as defined in Schedule 1 of this TER.

The main rule when awarding a grade for a unit of study is that students must pass all interim tests (obtaining 55 points or more) in order to be deemed to have passed the unit of study. This means that it is not possible to compensate for failed tests within a unit of study.

Units of study for which Schedule 1 of this TER states that compensation is possible are an exception to this rule. In that case, the rules that apply to compensation will be indicated for the unit of study. The final grade for a unit of study must, unrounded, always be at least 55 points.

### 128. Final grade

Students must pass every unit of study.

The grade for each unit of study (see Article [127. Grade for a unit of study](#)) is converted into a final grade on a grading scale from 1–10. This final grade is stated in the list of grades attached to the degree certificate. Final grades will be rounded off to the nearest whole number, as is customary in the Netherlands.

For a limited number of units of study, the final grade may be expressed as either a 'Pass' or a 'Fail'. That will be the case if it is impossible to express the grade as a grade, as this is fitting for the study programme.

However, only a very limited number of units of study can have a final grade of 'Pass' or 'Fail'. If students have too many units of study with exemptions or 'Pass' grades, they will be unable to achieve a 'with merit' or 'cum laude' designation. For more information about "with merit" and "cum laude" designations, see Articles [181. 'With merit'](#) and [182. 'Cum laude'](#).

## Chapter 12. Test results

### 129. Timeframe for issuing results for oral tests and practical assignments

The examiner determines the test results of oral tests and practical assignments after they have been completed. If possible, the examiner will let students know the approximate result immediately after the test.

Students receive their final results no later than ten working days after the test via the PeopleSoft academic monitoring system.

### 130. Timeframe for issuing results for written tests

Students receive their final results via the Peoplesoft academic monitoring system no later than fifteen working days after the test date or the final submission deadline of the test.

### 131. Timeframe for issuing results for special written tests

For some types of written tests, students receive their final results via the PeopleSoft academic monitoring system no later than twenty working days after the test date or final submission deadline of the test. These types of tests include research reports, work placement reports and theses. If these timeframes apply, this will be indicated under the details of the type of test in the unit of study description in the Moodle courses of Mathematical Engineering.

### 132. Alternative timeframes

The Examination Board can change the grading timeframes set out in Articles 129, 130 and 131. If they do so, they must state their reasons. The Examination Board will ensure that timeframes in respect of tests that are important for binding study recommendations are such that the recommendations can be issued on time. If timeframes are extended, students will be notified immediately.

### 133. Notification of results

Students will receive a message that their results have been recorded in the PeopleSoft academic monitoring system. They can make a copy of their results as evidence.

The message will advise students of their right to access their test work. See also Article [149. Right of access](#) The message will also tell students that they may appeal to the Examination Appeals Board via the digital [Complaints and Disputes](#) portal on Iris.

### 134. Reviewing results

If it becomes apparent, after a report from a student or during follow-up discussion of the test, that a grade is incorrect, the examiner can change the result. The provisions that applied when the examiner determined the first result also apply here.

### 135. Correction of grades

If the result in the academic monitoring system is not the same as the result previously communicated by the examiner, the student concerned can ask the examiner to change the result. The student must do so within four weeks of the date on which the result was entered in the academic monitoring system. He must submit documents to substantiate the request.

The student may appeal the examiner's decision not to change the result. The appeal should be submitted within six weeks to the Examination Appeals Board via the digital [Complaints and Disputes](#) portal on Iris.

### 136. Submission and retention of work, misplaced work

For every test, the examiner or an invigilator will establish that students are present and have submitted work by recording the fact on the attendance list.

Students should ensure that they keep a digital or physical copy of all submitted work outside a test session.

If the examiner is unable to determine a result because the work has been misplaced, the examiner will notify the Examination Board.

The student will have to take the test again. If necessary, the Examination Board can allow the student an additional test opportunity to do so.

The Examination Board will make a decision within thirty working days.

## Chapter 13. Irregularities, fraud and plagiarism

### 137. Rules relating to tests

The rules that apply to the completion of test sessions can be found:

- in the instructions for test sessions; and
- Moodle courses of Mathematical Engineering.

The Examination Board may set additional rules. If so, these rules will be published within the first two weeks after the start of the term. They will also appear on the test cover sheet.

The instructions deal with written test sessions but apply by analogy to other forms of tests.

In all tests, students must comply with these rules and with the instructions given by the invigilator, the examiner or the Examination Board.

### 138. Irregularities

If something happens during the test process that is not in compliance with the rules as set out in the TER, the regulations or the

instructions for test sessions, this is referred to as an irregularity. An irregularity *may* also be fraud or plagiarism, but this is not always the case.

As a result of irregularities, it may be determined that the test is invalid for one student, for all students who took part, or for a group of students who took part, even if they were not to blame for the irregularity. This decision will be made if it is no longer possible to conduct an accurate assessment of knowledge, understanding, skills or professional attitude. See also Articles [144. Grounds for a declaration of invalidity](#) and [145. Consequences of a declaration of invalidity](#).

### 139. Disturbance

If a student causes a disturbance during a test to the extent that it affects other students sitting the test, the invigilator may ask the student to leave the testing room. The invigilator will make a note in the protocol. The Examination Board will decide as soon as possible whether the invigilator did the right thing in asking the student to leave. In doing so, it will follow the procedure set out in Article 142.

If the student refuses to leave the testing room, the invigilator may decide to allow the student to remain to prevent additional commotion that could affect the other students. In this situation, the invigilator will not give the student's work to the examiner but will instead give it to the Examination Board. The invigilator will make a note of the event in the protocol.

The Examination Board will make a decision in the same manner as if the student had actually left the room. If the Examination Board decides that the request to the student to leave was not justified, the examiner will grade the student's work.

If the Examination Board decides that the student's removal was justified, this is considered to be the same as if the student had submitted a blank test paper. The student will be given a grade of 10 (on the grading scale from 10–100) or F (Fail).

If the Examination Board decides that the student's removal was not justified, the student may sit the test again. The Examination Board will decide when and how that will happen.

### 140. Fraud/serious fraud

1. Fraud is an act or omission by a student that makes it wholly or partially impossible to conduct an accurate assessment of their knowledge, understanding, skills or professional attitude. Examples of fraud include, but are not limited to, events when a student:

- a. uses materials during the test that they are not permitted to use;
- b. cheats during a test;
- c. gives information about a test to other people or receives such information, either inside or outside the testing room;
- d. makes up and/or falsifies survey or interview answers or research data;
- e. uses or reproduces another person's texts, reasoning, data or ideas without fully and correctly referencing the source (plagiarism).

2. Serious fraud includes, but is not limited to, events when a student:

- f. falsifies tests, for example by making changes to work after being granted an opportunity to view it;
- g. doing the test (or allowing it to be done) wholly or partially by or for another;
- h. falsifying and/or forging a signature;
- i. if the abovementioned under 1.d. and 1.e. occurs in a section of the graduation programme.

Repeated fraud may be designated as serious fraud.

### 141. Participating in fraud

Participating in fraud is also deemed to constitute fraud. Participating in fraud includes, but is not limited to:

- allowing students to cheat;
- giving information to or receiving information from another person during a test;
- giving someone the questions, tasks or model answers before or during a test;
- sitting a test or completing all or part of an assignment in another person's name.

This list of participating in fraud is not exhaustive.

## 142. Procedure in the event of irregularities and suspected fraud

### Report to the Examination Board

If an invigilator or examiner notices irregularities or suspects fraud before, during or after a test – while grading, for example – they will note it in the protocol that is drawn up for each test.

### Student rights and obligations

Students may be asked to submit all the documents, data or items that may have played a role in the – suspected - fraud. If a student refuses to do so, this will be noted in the protocol.

Students may have their comments regarding the event recorded in the protocol. In that event, they may sign the protocol, but they are not required to do so.

The invigilator or examiner will give the Examination Board:

- the protocol;
- supporting documents, if any; and
- the work completed by the student, if necessary.

### Postponement of grading

If irregularities or suspected fraud are uncovered before the work is graded, the work of the student involved will not be graded until the Examination Board has made a decision.

### Meeting

Before the Examination Board makes a decision, the student may tell their side of the story. A report of this meeting will be drawn up. Before the Executive Board makes a decision on a proposal to deregister the student, the student may tell their side of the story. A report of this meeting will be drawn up.

#### 1. *Decision-making*

The Examination Board will make a decision within 30 working days about whether fraud has occurred, based on:

- the written documents; and
- what the student said during the meeting.

If fraud is found to have occurred, the Examination Board will determine whether it was serious fraud.

The Examination Board will then decide on the measures to be taken. The possible measures are set out in Article 143.

## 143. Measures in the event of fraud

### Measures in the event of fraud

If fraud has occurred, the Examination Board will take measures that are appropriate to the fraud.

These measures are exclusively the following:

- The Examination Board confirms the measures taken by the examiner or invigilator.
- The student receives a written warning.
- The Examination Board declares the student's test invalid. In that case, the work will not be graded. If the work has already been graded, no grade will be entered in the PeopleSoft academic monitoring system. If there is already a grade in the system, it will be removed. In both cases, the letters ME (Measures of the Examination Board) will be entered.
- The Examination Board decides that the student may not take part in the next opportunity for the same test.
- The Examination Board decides that the student may not take part in any tests for a period determined by the Examination Board. That period will not exceed one year.

### Measures in the event of serious fraud

In the event of serious or repeated fraud, the Examination Board may recommend to the Executive Board that the student's enrolment in the programme be terminated. The Examination Board will consult the faculty director first.

## Chapter 14. Declaring results to be invalid

### 144. Grounds for a declaration of invalidity

The Examination Board may determine that a result is invalid if, after the result was announced, it was found that any of the following had occurred:

- an irregularity that made an accurate assessment impossible, even if the student(s) were not to blame for the irregularity;
- fraud;
- a ruling by an appeal body.

The Examination Board will make a decision within 30 working days after becoming aware of any of the above circumstances.

### 145. Consequences of a declaration of invalidity

If a result is declared to be invalid, the grade recorded for the student(s) concerned will be replaced with ME (Measure Examination Board). The Examination Board will inform the student(s) of its decision in writing, also informing them of their right of appeal.

If the work is to be re-graded and a new result determined, the Examination Board will instruct an examiner to do so. The new result will be recorded in place of the result that was removed.

## Chapter 15. Validity period of completed tests and obtained exemptions

### 146. Limited validity period for tests and exemptions

A test result has a limited validity period if the following two conditions both apply:

- The test result has an expiry date, which is indicated in Article [23. Expiry date, transition period and validity period](#) of this TER;
- and the knowledge, understanding or skills being assessed are demonstrably obsolete.

There are no education and test results with an expiry date for the programme.

### 147. End of validity period

The validity period for an obsolete test result with an expiry date will end:

- for the foundation phase: three years after the first enrolment;
- for an accelerated programme: two years and eight months after the first enrolment;
- for the main phase of the Bachelor's programme: five years after the first enrolment for the main phase. If the student has an exemption for the foundation phase: five years after the first enrolment.

### 148. End of validity period

#### a. Extension and special circumstances

The Examination Board may extend the validity period for students:

- with special circumstances, as described in the Profile Fund (see Chapter 3 of this Education Guide);
- and for whom the validity period in Article 147 is too short.

They do not have to comply with the other conditions in Article [85. Definition of personal circumstances](#).

The Examination Board will ask the student counsellor for advice about:

- whether the special circumstances fall within the scheme; and
- how much of a delay the special circumstances have caused to the student's studies.

#### b. Extension in other circumstances

If there are any special circumstances other than those referred to above under a), and in the opinion of the Examination Board



they have caused a delay in a student's studies that is not adequately compensated for by the validity period for the tests, the Examination Board may extend the validity period. The student in question must submit a request to that effect to the Examination Board.

The student may submit a new request if new special circumstances arise or the circumstances continue.

For the reporting of a study completion delay due to special circumstances and the resulting further activities, the procedure in Article [87. Procedure for establishing special and personal circumstances](#) applies. This is not the case if that procedure already applies based on other rules in the Education Guide.

Students must submit the extension request:

- electronically;
- stating reasons why they are asking for an extension;
- and before the validity period expires.

Where a student submits a request late but has a good reason for doing so, the Examination Board will still accept the request for handling.

The Examination Board will make its decision within 30 working days after the complete request is submitted.

## Chapter 16. Accessing, discussing and requesting copies of tests

### 149. Right of access

Students are entitled to view and discuss their graded work. They can do so at the latest up to four weeks after notification of the result of a written test via the PeopleSoft academic monitoring system.

Programmes determine when and where students can view and discuss their work. This may also take place digitally. When they view their work, students can also see the test standards that were used.

The Examination Board may instruct students how to view their work, for example to prevent students from disseminating test material.

### 150. Right to obtain a copy in the event of a dispute

If a student and an examiner disagree on a result, a copy of the work (or relevant part thereof) which they disagree on will be created, free of charge. The student needs this copy in order to lodge an appeal. The student must request the copy personally.

## Chapter 17. Retention of tests

### 151. Original retained by the university

The university will always keep the original of important written documents, such as important essays, work placement reports, research reports, theses and components of graduation programmes.

### 152. Retention period

The university will retain these documents, as well as final research projects, examinations and assignments that students have produced in this respect for a minimum of seven years. They may be kept in electronic or hard copy format. The university will retain these documents for longer if that is stated in the university's regulations governing retention periods.

The university will retain other student work and recordings of oral tests which are not covered by the above list of documents for two years. This is in accordance with the university's regulations governing retention periods.

### 153. Inclusion in university records to comply with statutory obligations

A copy of the documents referred to in Articles 151 and 152 will be kept in a file or archive to be used for the work of the university. This will be done only if the documents are deemed to be suitable for this purpose. The documents are necessary in order to comply with statutory obligations, such as a visit/accreditation. They may be consulted if that is in line with the

university's objectives.

The same applies to inclusion in the HBO Knowledge Base: [www.hbo-kennisbank.nl](http://www.hbo-kennisbank.nl).

If the documents contain confidential information or if third parties have rights to the work, this will be respected. However, a work as a whole cannot be regarded as confidential.

#### 154. Keeping and retaining a (digital) portfolio

The programme does not work with a (digital) portfolio.

## Chapter 18. Exemptions

#### 155. Exemptions from tests

The Examination Board may decide that a student does not have to complete any tests for a particular unit of study or a module. This is called an 'exemption'.

#### 156. Unit of study exemptions

Students will be given an exemption for a unit of study if they have been granted exemptions for all tests in that unit of study.

#### 157. Exemptions after switching programmes within the university

If students switch to another programme within the university, they can take their test results and exemptions with them only if they have applied for exemptions in this respect. The same applies to any results students have previously obtained in study programmes at the university that are not government-funded.

#### 158. Exemption criteria

Students may be granted exemptions if they:

- have previously passed tests and examinations within the higher education system;
- have demonstrably acquired knowledge and skills outside of the higher education system which are approximately the same as the unit of study/module and associated test(s) in terms of:
  - content;
  - level;
  - required final qualifications.

If a student requests an exemption based on tests completed in a foreign institution, the Examination Board will consider the quality of the institution in its decision. The evaluation of quality will be based on a previous investigation by the university or on the Examination Board's own investigation.

#### 159. Exemptions granted solely based on up-to-date knowledge and experience

The Examination Board will grant exemptions only based on up-to-date knowledge and experience.

Generally, the Examination Board applies a period of five years when considering what 'up to date' is. In other words, the tests or examinations must have been completed no more than five years before the date of the exemption application. The same applies to knowledge and skills acquired outside of the higher education system.

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#### 160. Exemptions procedure and evidence

Requests for exemptions must be submitted to the Examination Board in writing (or by email). Students must explain the reasons why they are asking for an exemption and enclose supporting documents.

The Examination Board may ask a student to provide further information or additional documents. It may also request any information it deems to be necessary in order to make a decision.

Supporting documents may include:

- copies of certificates bearing the stamp of the relevant organisation;

- transcripts showing tests and examinations, or certificates; the student must provide a full description of study or degree programmes or relevant components thereof. The same applies to results previously achieved as a contract student in the same programme at the university;
- copies of theses, articles, reports or coursework that:
- have been written by the student; and
- have been assessed and certified by an authorised body;
- a stamped copy of an APL report issued in accordance with the APL Quality Code by an accredited APL provider. The report must clearly show that the student has the knowledge and skills required for the requested exemption; the student must also provide the associated documents if the Examination Board asks for them.

The Examination Board will make a decision on a complete exemption application within 30 working days. The Examination Board may extend this timeframe once, by a maximum of 30 working days.

#### 161. Further investigation

If the Examination Board determines, on the basis of an investigation, that a student cannot be granted an exemption for all tests in a unit of study, the Examination Board may decide to grant an exemption following a further investigation. This investigation involves a comparison by the Examination Board of the final qualifications that the student is lacking against the content of the unit of study.

The investigation may entail that the student must pass an ordinary test.

In its decision, the Examination Board will set a deadline by which the further investigation must be successfully completed.

If a student sits tests which are covered by the exemption, it will be assumed that they did so in the context of this investigation. If the student fails the test, they will not be granted an exemption for all the tests.

The Examination Board may determine that the validity of a result will end earlier than the date resulting from the general exemptions policy (see Articles [146. Limited validity period for tests and exemptions](#) t/m 148). The Examination Board may do so when:

- the student's request relates to an exemption they previously received for another programme at the university;
- or the programme is being updated.

#### 162. Waiving further investigation

If the Examination Board decides that a component of a test is not essential in terms of the conditions as specified in the unit of study description regarding the acquisition of the knowledge, understanding and skills required to obtain the degree, it may decide not to conduct an investigation into that component. This may only occur in an exceptional case, such as disability or religious belief. It also depends on the reasons given by the student.

#### 163. Exemptions prior to enrolment

The Examination Board may also decide to grant an exemption before a student is enrolled. In that case, the student will receive the exemption only once they have actually enrolled.

#### 164. Exemption from foundation examination

If a student has obtained an exemption for all foundation phase tests, he is deemed to be exempt from the foundation examination, unless the Examination Board has conducted its own investigation as described in Article [173. Examination Board investigation](#).

In that case, the student will not receive a foundation certificate.

#### 165. No exemption from final examination

Students can only obtain a limited number of exemptions for the final examination of a Bachelor's programme.

For this final examination, students must obtain a minimum of 60 credits by successfully completing tests. This includes units of study connected with a graduation programme or part thereof. In the case of an accelerated pre-university education pathway, this will be a minimum of 45 credits. This includes units of study connected with a graduation programme or part thereof.

#### 166. Recording exemptions

If an exemption is granted for a test, the word 'vrijstelling' (exemption), or the abbreviation 'VR', will be recorded in place of the test result in the PeopleSoft academic monitoring system. This will be based on the date on which the student is notified of the decision. If this date is prior to the date of enrolment, the date of enrolment will be used.

## Chapter 19. Unit of study substitution; national and international mobility

#### 167. Request for substitution

Students may request the Examination Board to let them substitute one or more of the units of study which they still need to complete, along with the associated tests, with units of study and associated tests from another programme offered by the university or by another Dutch or foreign institution of higher education. Students must explain the reasons for their request. This is subject to the condition that students still meet the requirements of the examination, and that the study load in credits must remain the same.

The Examination Board will make its decision within 30 working days after the complete request is submitted.

#### 168. No request required

Students do not need to submit a request if there is a partnership agreement between the university and another institution in the Netherlands or abroad.

#### 169. Rules for teaching and testing in the case of a substitution

Any classes taken and tests completed at other institutions will be subject to the rules for teaching and testing of that institution. This does not apply if the Examination Board decides otherwise in this respect.

#### 170. Other conditions

The Examination Board may impose other conditions on the substitution of units of study and the associated tests. The substitution of units of study and associated tests with those of a foreign institution is subject to the condition that the quality of the foreign institution can be established by the Examination Board, based on:

- a previous investigation by the university;
- or the Examination Board's own investigation.

The Examination Board may also seek advice from Nuffic (the Dutch organisation for internationalisation in education).

# PART 9. EXAMINATIONS, DEGREE CERTIFICATES AND TRANSCRIPTS

## Chapter 1. Examinations

### 171. Foundation and final examination

The programme includes both a foundation examination and a final examination.

### 172. Requirements for passing the examination

Students have passed the foundation examination if:

- they have passed the tests for all units of study that are part of the foundation phase of the programme;
- and the validity period of those tests has not expired.

This does not apply if the Examination Board decides to conduct its own investigation, as described in Article 173.

Students have passed the final examination if:

- they have passed the tests for all units of study that are part of the main phase of the programme;
- and the validity period of those tests has not expired.

This does not apply if the Examination Board decides to conduct its own investigation, as described in Article 173.

### 173. Examination Board investigation

The Examination Board may decide that the examination, in addition to the tests in the programme, will include an investigation conducted by the Examination Board itself into students' knowledge, understanding and research.

This investigation is more or less the same as a test.

The Examination Board of the programme does not conduct its own investigation.

### 174. Requirements for passing the examination

In exceptional cases, the Examination Board may decide that students do not have to pass every part of a test in order to be deemed to have passed the examination. The Examination Board may set conditions for such a decision. Examples of exceptional cases are a disability or religious belief.

The Examination Board may make such a decision if it considers that a component of a test is not essential in terms of the requirements specified in the unit of study description for acquiring the knowledge, understanding and skills required to obtain the degree.

The Examination Board will then determine the final grade for the unit of study in a fair and reasonable manner, as much as possible in accordance with the rules set out in the TER. In doing so, the Examination Board will not give any consideration to the component in question.

## Chapter 2. Degree certificates and transcripts

### 175. Degree certificate

The Examination Board awards a degree certificate to students as proof that they have passed their final examination.

The Examination Board may decide to award the degree certificate only if the Central Student Administration declares that the student has paid all amounts due and payable by the student.

The degree certificate states the date on which the student is deemed to have passed the final examination. This is the date on which the student completed his/her last test. If the Examination Board has conducted its own investigation as described in Article [173](#), then the date on the certificate will be the date of the investigation.

The certificate will also state the name of the degree that has been awarded by the Executive Board.

The Examination Board awards degree certificates within five to eight weeks after students pass the final examination. The student will receive a notification with a request to check the data that will be displayed on the degree certificate. The Examination Board will then invite the student for the ceremony in which the certificate is awarded. If an Examination Board does not take the initiative to award a student's degree certificate, the student must request the Examination Board to award the certificate.

#### **176. List of grades and diploma supplement**

The Examination Board provides a list of grades with the degree certificate and also encloses a diploma supplement, except in the case of the foundation certificate.

#### **177. Deferral of awarding of the degree certificate**

If a student is entitled to receive a degree certificate but wishes to wait because it would be more advantageous to do so, and if the advantage the student would obtain is reasonable, then the student may request a deferral from the Examination Board using the designated form. On the form, the student should explain why the deferral is important to him and how long he wants to wait.

This is usually so that the student can complete an additional unit of study and have it included in the list of grades as an extracurricular unit of study, and not for the purpose of completing a second study programme. Deferrals are generally for no longer than six months. In any event, it is a condition of a deferral that the student not interrupt their enrolment. Note: deferrals can have consequences, for example for the student travel product. This should be checked with the Education Executive Agency (DUO).

#### **178. Transcript**

If a student has passed more than one test and the Examination Board does not award a degree certificate to the student, the student will receive a transcript from the Examination Board upon his request. At a minimum, the transcript will specify:

- the units of study for which the student passed the tests;
- the number of credits for those units of study;
- when the student passed the tests.

## **Chapter 3. With merit and cum laude designations**

#### **179. Recording on the degree certificate**

The Examination Board may record a 'with merit' or 'cum laude' designation on the degree certificate for each examination for which a positive result has been achieved.

For the final examination, the Examination Board only counts the results from the main phase.

#### **180. Basis of calculation**

In performing the calculation, the Examination Board will use the final grades before rounding off for the units of study of the examination.

If a unit of study has several tests, this concerns the final grade before rounding off for that unit of study based on the calculation of the average in accordance with Articles [127. Grade for a unit of study](#) and [128. Final grade](#).

In addition, the student must not have been studying for a longer period than the study duration as scheduled by the university. This does not apply if the longer study duration is due to personal circumstances or other special circumstances. The Examination Board will determine whether this is the case. Delay in a student's studies, which has demonstrably occurred as a result of coronavirus measures, will be regarded as a special circumstance.

### 181. 'With merit'

The designation of 'with merit' will be recorded on the degree certificate if:

- the weighted average final grade for all units of study is 7.0 or more;
- of these final grades, no grade is less than 6.5 before rounding off; and
- the student has received no more than 15 credits' worth of exemptions in the case of a 240 credits programme, or 11 credits in the case of a 180 credits programme.

In calculating the weighted average final grade, the Examination Board will not take into account the results for units of study that were awarded a 'Pass' or 'Fail' grade. A student can request the Examination Board to calculate the result from a foreign institution into a grade, so the grade can be taken into account for the weighted average final grade.

If a student has received more than 15 credits' worth of exemptions in the case of a 240 credits programme, or 11 credits in the case of a 180 credits programme, they may still obtain the 'with merit' designation if:

- the actual duration of the student's studies was correspondingly shorter due to these exemptions; and
- the number of credits for the final examination which the student achieved through tests, amounts to at least half of the total number of credits for that examination.

### 182. 'Cum laude'

The designation 'cum laude' will be recorded on the degree certificate if:

- the weighted average final grade for all units of study is 8.0 or more;
- of these final grades, no grade is less than 7.0 before rounding off; and
- the student has received no more than 15 credits' worth of exemptions (in the case of an accelerated pre-university pathway, 11 credits).

In calculating the weighted average final grade, the Examination Board will not take into account the results for units of study that were awarded a 'Pass' or 'Fail' grade. A student can request the Examination Board to calculate the result from a foreign institution into a grade, so the grade can be taken into account for the weighted average final grade.

If a student has received more than 15 credits' worth of exemptions in the case of a 240 credits programme, or 11 credits in the case of a 180 credits programme, they may still obtain the 'cum laude' designation if:

- the actual duration of the student's studies was correspondingly shorter due to these exemptions; and
- the number of credits for the final examination which the student achieved through tests, amounts to at least half of the total number of credits for that examination.

Moreover, for the final examination the final grade before rounding off for the units of study that form part of the graduation programme must be at least 8.0. Schedule 1 of this TER sets out which unit of study will be the determining factor for the designation 'cum laude'.

## PART 10. FINAL AND TRANSITIONAL PROVISIONS

### 183. Updating the TER

The TER will not be changed during the academic year, unless the interests of students will not be adversely affected by the change. It can be the case that, in spite of the previous provision, the coronavirus measures make changes necessary. In the event of these changes, the contents hereof must be taken into consideration.

### 184. Unforeseen circumstances

In any situations not provided for by the TER, a decision will be made by:

- the Executive Board, if the situation concerns general provisions;
- the faculty director responsible for the programme, if the situation concerns programme-specific provisions.

When implementing the TER, if staff members cannot agree on who has authority in a particular situation, the Executive Board will designate the competent body.

### 185. Publication, entry into force and authentic version

This TER forms part of the Education Guide of the university as referred to in Section 7.59 of the WHW

The Executive Board may extend the period of validity of general provisions of the TER. This can only be done for an entire academic year. The representative advisory council must give consent for the extension.

The faculty director can extend the period of validity of the programme-specific information. This can only be done for an entire academic year. The representative advisory council must give consent for the extension.

In the event of a discrepancy or difference of interpretation of the provisions of the TER, the text of the Dutch version will take priority over any version in another language.



## Appendix: Annual Programmes

Programme: **Toegepaste Wiskunde** Faculty: **Engineering, Design, Computing** Mode of study: **full-time**

### Overview units of study

#### Legend

AF	Graduation part
PR	Graduation part designation
KE	Qualitative requirement (BSR)
BD	Professional component
OP	Optional professional or educational component
EW	Requirements for the job
KZ	Choice whether there are requirements for the job
C	Compensation within the unit of study

#### Academic year 1

Unit of study	Code	Term	ECTS	Specific details
<b>Basic curriculum</b>				
<u>IT Essentials</u>	3719IT111Z	■ ■ ■ ■	5	
<u>Professional skills 1</u>	3719IT112Z	■ ■ ■ ■	1	
<u>English 1</u>	3713IT114Z	■ ■ ■ ■	2	KE
<u>Programming with Python 1</u>	3718IT113Z	■ ■ ■ ■	3	
<u>Precalculus</u>	3714IT116Z	■ ■ ■ ■	4	KE
<u>Calculus 1</u>	3714IT121Z	■ ■ ■ ■	4	
<u>Programming with Python 2</u>	3718IT122Z	■ ■ ■ ■	3	
<u>Project Casual Graphics</u>	3718IT123Z	■ ■ ■ ■	4	
<u>Professional skills 2</u>	3719IT124Z	■ ■ ■ ■	1	
<u>Statistics 1</u>	3719IT125Z	■ ■ ■ ■	3	
<u>Research 1</u>	3720IT131Z	■ ■ ■ ■	3	
<u>DBMS 1</u>	3720IT134Z	■ ■ ■ ■	3	
<u>Linear Algebra</u>	3719IT133Z	■ ■ ■ ■	4	

Unit of study	Code	Term	ECTS	Specific details
<u>English 2</u>	3713IT144Z	■ ■ ■ ■	2	
<u>Statistics 2</u>	3720IT135Z	■ ■ ■ ■	2	
<u>ME learning challenge 1</u>	3720IT136Z	■ ■ ■ ■	1	
<u>Project Databases</u>	3719IT141Z	■ ■ ■ ■	4	
<u>Professional skills 3</u>	3719IT142Z	■ ■ ■ ■	1	
<u>DBMS 2</u>	3714IT143Z	■ ■ ■ ■	3	
<u>Statistics 3</u>	3719IT144Z	■ ■ ■ ■	3	
<u>Calculus 2</u>	3714IT136Z	■ ■ ■ ■	4	

## Academic year 2

Unit of study	Code	Term	ECTS	Specific details
<b>Basic curriculum</b>				
<u>Geometry</u>	3713IT223Z	■ ■ ■ ■	3	
<u>English 3</u>	3719IT212Z	■ ■ ■ ■	3	
<u>Object Oriented Programming 1</u>	3719IT213Z	■ ■ ■ ■	4	
<u>Statistics 4</u>	3719IT214Z	■ ■ ■ ■	3	
<u>Professional skills 4</u>	3719IT215Z	■ ■ ■ ■	1	
<u>Object Oriented Programming 2</u>	3719IT222Z	■ ■ ■ ■	3	
<u>Project Application Development</u>	3713IT221Z	■ ■ ■ ■	5	
<u>Software Engineering</u>	3719IT211Z	■ ■ ■ ■	4	
<u>Operations Research</u>	3713IT334Z	■ ■ ■ ■	4	
<u>Numerical Analysis</u>	3719IT231Z	■ ■ ■ ■	3	
<u>English 4</u>	3719IT232Z	■ ■ ■ ■	3	
<u>ME learning challenge 2</u>	3719IT233Z	■ ■ ■ ■	1	
<u>Graph Theory</u>	3719IT234Z	■ ■ ■ ■	3	
<u>Object Oriented Programming 3</u>	3719IT235Z	■ ■ ■ ■	3	
<u>Research 2</u>	3713IT235Z	■ ■ ■ ■	2	
<u>Project Web Science</u>	3719IT241Z	■ ■ ■ ■	4	
<u>Cryptography</u>	3711IT423Z	■ ■ ■ ■	3	

Unit of study	Code	Term	ECTS	Specific details
<u>Professional skills 5</u>	3719IT243Z	■ ■ ■ ■	1	
<u>Algorithms &amp; Datastructures</u>	3719IT244Z	■ ■ ■ ■	5	
<u>Management &amp; Organization</u>	3719IT245Z	■ ■ ■ ■	2	

### Academic year 3

Unit of study	Code	Term	ECTS	Specific details
<b>Basic curriculum</b>				
<u>Internship</u>	3711IT321Z	■ ■ ■ ■	30	

### Academic year 4

Unit of study	Code	Term	ECTS	Specific details
<b>Basic curriculum</b>				
<u>Data Mining &amp; Analysis</u>	3711IT411Z	■ ■ ■ ■	4	
<u>Advanced Data Disclosure</u>	3718IT411Z	■ ■ ■ ■	4	
<u>ME learning challenge 4</u>	3718IT412Z	■ ■ ■ ■	1	
<u>Cryptography</u>	3711IT423Z	■ ■ ■ ■	3	
<u>Research 4</u>	3711IT422Z	■ ■ ■ ■	2	
<u>Study Career Coaching 6 (SCC)</u>	3712IT425Z	■ ■ ■ ■	1	
<u>Project Big Data</u>	3711IT421Z	■ ■ ■ ■	5	
<u>Business Intelligence</u>	3715IT422Z	■ ■ ■ ■	2	
<u>Emerging Technologies</u>	3715IT424Z	■ ■ ■ ■	5	
<u>Distributed Systems and Parallel Computing</u>	3712IT412Z	■ ■ ■ ■	3	
<u>Individual Project (Thesis)</u>	3710IT444Z	■ ■ ■ ■	30	AF PR

## Overview of tests

### Legend

GRD	Grade assessment scale with the minimum score in parenthesis
SUS	Pass / fail scale
0%-100%	Weighting factor
SBU	Number of study hours
S/M/AW	Examination format (Written, Oral, Other method)

TZ	Examination session
AP	Compulsory attendance
LN	Longer timeframe for issuing results

### Academic year 1

Unit of study	Test	Code	Scale	Weight	SBU	Mode	Specific details
<b>Basic curriculum</b>							
IT Essentials	IT Essentials	3719IT111A	GRD(55)	100%	140	S	TZ AP
Professional skills 1	Professional skills 1	3719IT112A	GRD(55)	100%	28	S	AP
English 1	English 1	3713IT114A	GRD(55)	100%	56	S	TZ AP
Programming with Python 1	Programming with Python 1	3718IT113A	GRD(55)	100%	84	S	TZ AP
Precalculus	Precalculus	3714IT116A	GRD(55)	100%	112	S	TZ
Calculus 1	Calculus 1	3714IT121A	GRD(55)	100%	112	S	TZ
Programming with Python 2	Programming with Python 2	3718IT122A	GRD(55)	100%	84	S	TZ AP
Project Casual Graphics	Project Casual Graphics	3718IT123A	GRD(55)	100%	112	AW	AP
Professional skills 2	Professional skills 2	3719IT124A	GRD(55)	100%	28	S	AP
Statistics 1	Statistics 1	3719IT125A	GRD(55)	100%	84	S	TZ AP
Research 1	Research 1	3720IT131A	GRD(55)	100%	84	S	TZ AP
DBMS 1	DBMS 1	3720IT134A	GRD(55)	100%	84	S	TZ AP
Linear Algebra	Linear Algebra	3719IT133A	GRD(55)	100%	112	S	TZ AP
English 2	English 2	3713IT144A	GRD(55)	100%	56	S	TZ AP
Statistics 2	Statistics 2	3720IT135A	GRD(55)	100%	56	S	TZ AP
ME learning challenge 1	ME learning challenge 1	3720IT136A	GRD(55)	100%	28	AW	AP
Project Databases	Project Databases	3719IT141A	GRD(55)	100%	112	AW	AP
Professional skills 3	Professional skills 3	3719IT142A	GRD(55)	100%	28	S	AP
DBMS 2	DBMS 2	3714IT143A	GRD(55)	100%	84	S	TZ AP
Statistics 3	Statistics 3	3719IT144A	GRD(55)	100%	84	S	TZ AP
Calculus 2	Calculus 2	3714IT136A	GRD(55)	100%	112	S	TZ

## Academic year 2

Unit of study	Test	Code	Scale	Weight	SBU	Mode	Specific details
Basic curriculum							
Geometry	Geometry	3713IT223A	GRD(55)	100%	84	S	TZ
English 3	English 3	3719IT212A	GRD(55)	100%	84	S	TZ
Object Oriented Pro- gramming 1	Object Oriented Pro- gramming 1	3719IT213A	GRD(55)	100%	112	S	TZ
Statistics 4	Statistics 4	3719IT214A	GRD(55)	100%	84	S	TZ
Professional skills 4	Professional skills 4	3719IT215A	GRD(55)	100%	28	S	AP
Object Oriented Pro- gramming 2	Object Oriented Pro- gramming 2	3719IT222A	GRD(55)	100%	84	S	
Project Application De- velopment	Project Application De- velopment	3713IT221A	GRD(55)	100%	140	AW	AP
Software Engineering	Software Engineering	3719IT211A	GRD(55)	100%	112	S	TZ
Operations Research	Operations Research	3713IT334A	GRD(55)	100%	112	S	TZ
Numerical Analysis	Numerical Analysis	3719IT231A	GRD(55)	100%	84	S	TZ
English 4	English 4	3719IT232A	GRD(55)	100%	84	S	TZ
ME learning challenge 2	ME learning challenge 2	3719IT233A	GRD(55)	100%	28	AW	AP
Graph Theory	Graph Theory	3719IT234A	GRD(55)	100%	84	S	TZ
Object Oriented Pro- gramming 3	Object Oriented Pro- gramming 3	3719IT235A	GRD(55)	100%	84	S	
Research 2	Research 2	3713IT235A	GRD(55)	100%	56	S	
Project Web Science	Project Web Science	3719IT241A	GRD(55)	100%	112	AW	AP
Cryptography	Cryptography	3711IT423A	GRD(55)	100%	84	S	TZ
Professional skills 5	Professional skills 5	3719IT243A	GRD(55)	100%	28	S	AP
Algorithms & Datastruc- tures	Algorithms & Datastruc- tures	3719IT244A	GRD(55)	100%	140	S	TZ
Management & Organi- zation	Management & Organi- zation	3719IT245A	GRD(55)	100%	56	S	TZ

## Academic year 3

Unit of study	Test	Code	Scale	Weight	SBU	Mode	Specific details
Basic curriculum							
Internship	Internship	3711IT321A	GRD(55)	100%	840	AW	AP

#### Academic year 4

Unit of study	Test	Code	Scale	Weight	SBU	Mode	Specific details
<b>Basic curriculum</b>							
Data Mining & Analysis	Data Mining & Analysis	3711IT411A	GRD(55)	100%	112	S	TZ
Advanced Data Disclosure	Advanced Data Disclosure	3712IT411A	GRD(55)	100%	112	S	TZ
ME learning challenge 4	ME learning challenge 4	3718IT412A	GRD(55)	100%	28	AW	
Cryptography	Cryptography	3711IT423A	GRD(55)	100%	84	S	TZ
Research 4	Research 4	3711IT422A	GRD(55)	100%	56	S	
Study Career Coaching 6 (SCC)	Study Career Coaching 6 (SCC)	3712IT425A	GRD(55)	100%	28	AW	
Project Big Data	Project Big Data	3711IT421A	GRD(55)	100%	140	AW	AP
Business Intelligence	Business Intelligence	3715IT422A	GRD(55)	100%	56	S	
Emerging Technologies	Emerging Technologies	3715IT424A	GRD(55)	100%	140	S	TZ
Distributed Systems and Parallel Computing	Distributed Systems and Parallel Computing	3712IT412A	GRD(55)	100%	84	S	
Individual Project (Thesis)	Individual Project (Thesis)	3710IT444A	GRD(55)	100%	840	AW	AP

# Year 1

## Basic curriculum

### Term 1

## IT Essentials - 3719IT111Z

Content of unit of study	<p>A Mathematical Engineer works on the cutting edge of mathematics and information technology, applying the first in the second. Many if not most of these applications are built-in software and run on computer hardware.</p> <p>In order to understand the consequences of the underlying hardware – and middleware - he/ she needs an understanding of the technology used. While it is unnecessary to understand each and every detail, a good overview is required as well as some insight in what's going on under the hood. As an added bonus this allows the engineer to solve many issues himself instead of having to rely on technical support.</p> <p>This course will cover the IT infrastructure as it is used at many organisations, both large and small. Discussed are personal computers, peripherals (for example printers), the network and the functioning of a service desk. The course prepares for taking the CompTIA+ exam; this can be done at an external testing centre and is not included in the course.</p>
Learning outcomes	<p>2.1.3 - Create the design of a delimited part of an app, application or information system using a given modelling technique.</p> <p>3.1.2 - Build, test and deliver a prototype of an app, application or information system.</p> <p>4.1.3 - Use management protocols and systems for data management.</p> <p>7.1.1 - Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background.</p> <p>8.1.3 - Apply knowledge, insights and skills.</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: IT Essentials - 3719IT111A

Assessment objectives/criteria	<p>After successfully completing this module, the student is able to:</p> <ul style="list-style-type: none"><li>■ Explain the general structure and working of a computer system (8.1.3)</li><li>■ Plan and execute preventive and corrective maintenance on a simple IT infrastructure (4.1.3)</li><li>■ Select relevant sources on hardware, middleware and software aimed at a specific domain (7.1.1)</li><li>■ Design a specialized computer system for a given purpose (2.1.3)</li><li>■ Install, configure and troubleshoot a personal computer or laptop and its connection to a local network and peripherals (3.1.2)</li></ul>
Details of assessments	<p>Each chapter is tested with an online chapter test. These are to be done after class, and have to be finished before next class starts.</p> <p>The course is finalized with two exams:</p> <ul style="list-style-type: none"><li>■ An exam on the computer to test theoretical knowledge and understanding.</li><li>■ Several practical test on computer components, electronics and troubleshooting to test practical skills, done during classes</li></ul>
Strategies and	Classes usually starts with a speed presentation of the theory that week (going over all chapters that week)

teaching activities	<p>or a demonstration of some practical skill, and is meant for students to ask questions on those elements they did not (yet) fully grasp. Most of the class is used to do practical work and exercises. Because there is little time reserved for theory, students are required to quick-read the relevant chapters before class and read the materials again in detail after class.</p> <p>After a class, students have one week to do the chapters tests for that week. These are part of the final grade as well.</p>	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	None for the final exam none. All for the practical tests.	

## Professional skills 1 - 3719IT112Z

Content of unit of study	<p>Studying is far more than just gathering knowledge and getting a degree. En route towards the degree, acquiring certain skills and gaining a professional attitude are intertwined with your development into a professional</p> <p>Within the University of Applied Sciences (Hbo) we mainly focus on acquiring 'competences'. In Holland uses the following definition of 'competences': 'the mental tools that allow you to execute various professional tasks. Apart from knowledge, it also means forming and developing skills, insight and attitude. Combined, this will provide the graduate with the ability to act adequately in critical professional situations, and to reflect upon this'</p> <p>In Professional skills you learn how to manage your own study career. You learn to recognize and use your strong points, become aware of your limitations, and, as a result of this, know how to make your own plan of action. One of the lecturers of Information Technology will be assigned to be your study career coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>Professional skills is both an individual process and a group, collaborative process.</p>	
Learning outcomes	<p>After successfully completing this module, the student is able to:</p> <p>8.1.2 Reflect on own behaviour and give and receive feedback in an appropriate way.</p> <p>8.1.3 Apply knowledge, insights and skills.</p> <p>8.1.4 Demonstrate an appropriate (study) attitude.</p> <p>8.1.6 Contribute to a respectful study environment.</p> <p>8.1.7 Work according to agreements and planning.</p>	
Requirements for participation in units of study (See also Article 29 TER)	No	
Specific details		

### Assessment: Professional skills 1 - 3719IT112A

Assessment objectives/criteria	<p>Written assignments:</p> <ul style="list-style-type: none"> <li>■ Personal development plan</li> <li>■ SWOT - outline Strengths, Weaknesses, Opportunities and Threats</li> <li>■ SMART Goals - Specific, Measurable, Acceptable, Realistic and Time-bound</li> </ul> <p>A personal development plan is a process that consists of defining what is important to you, what you want to achieve, what strengths you already have that help to achieve your goals, and what you need to improve and develop with time.</p>
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	<p>Written assignments, class sessions and personal interviews are assessed on the following criteria:</p> <ul style="list-style-type: none"> <li>■ Reflect on own behaviour and give and receive feedback in an appropriate way (8.1.2)</li> <li>■ Identifying interests, values or skills to set learning, life or career goals (8.1.3)</li> <li>■ Exploring, selecting or adapting strategies and resources that support personal growth in life and school (8.1.4, 8.1.6 and 8.1.7)</li> </ul>	
Details of assessments	<p>Written assignments and class sessions</p> <p>Furthermore consultation with coach with respect to study progress</p>	
Strategies and teaching activities	<p>The instructional format and educational activities consist of 7 x 2 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; written assignments and consultation with coach regarding study progress.</p>	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids		

## English 1 - 3713IT114Z

Content of unit of study	<p>Students enrolling in this course come both from the Netherlands and abroad will already have a good command of the English language in order to follow the ME courses, which are all taught in the English language.</p> <p>Nevertheless, English is an important language in the field of technology, especially mathematics and information technology. Written and verbal communication forms an even greater importance as a foundation to business communication.</p> <p>During the English courses the emphasis will be on reading, writing, listening, speaking and communicating. The courses start with an emphasis on acquiring new English vocabulary (formal vs informal), reviewing English grammar and will subsequently focus on speaking and writing. Especially writing will be the focus of attention and be presented in the form of letters, memos, research essays and reports. These assignments will be spread out over the 5 modules of English given in years 1 and 2. Developing professional English skills prepares the student not only for the final thesis, but also for the professional work field.</p> <p>English 1: this course aims at bringing your reading level up to C1 and level of writing to level B1.</p>	
Learning outcomes	<p>8.1.5 Communicate effectively, both orally and in writing.</p> <p>8.1.7 Work according to agreements and planning.</p>	
Requirements for participation in units of study (See also Article 29 TER)	None.	
Specific details	Prerequisites: none, except that the level of English should at least be at B1CEF.	

### Assessment: English 1 - 3713IT114A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ <b>Assessment criteria</b> <p><b>Components</b> - Accurately uses correct business letter format (heading, greeting, introduction, body, closure, signature, enclosure, and copy)</p> <p><b>Content</b> - Letter clearly states the purpose - uses Appropriate explanations or facts used to support the main idea "</p> <p><b>Appearance</b> - using correct spacing, font, and format and lay-out</p> </li> </ul>
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	<p><b>Language Usage</b> - Accurate use of punctuation and grammar, vocabulary at B1/B2 level, No spelling errors</p> <p><b>PRESENTATION</b>  <b>Assessment criteria</b>  The presentation is assessed on the following criteria:</p> <ul style="list-style-type: none"> <li>Used aids in media, such as PowerPoint, Prezi, Rocket Slide etc., attractiveness of the presentation</li> <li>Topic, complexity or execution of the assignment</li> <li>Pronunciation</li> <li>Structured presentation: introduction, body, conclusion, sign-posting, presentation techniques, attitude in front of the class, meeting conventions for presentations</li> <li>Interaction with class during questions</li> </ul> <p>Students attending the presentation are required to ask questions, have a participative attitude and a keen sense for facts versus opinions. Audience participation is mandatory and roles will be divided for giving feedback.</p>	
Details of assessments	Written assignments without a formal test sitting. In class presentation (P/F).	
Strategies and teaching activities	The instructional format and educational activities consist of 7 x 4 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; an in-term presentation which forms part of the final grade, followed by an individual exam (written assignment)	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	Individual writing assignments – written outside of class - aids and sources permitted.. Presentation: to be decided by student(s). (PowerPoint, Prezi, other)	

## Programming with Python 1 - 3718IT113Z

Content of unit of study	<p>This course gives a first introduction to programming in general and more specific to programming with Python.</p> <p>The subject covered in this course are datatypes, operators and expressions, control flow, functions and datastructures in Python.</p> <p>After successfully completing this course, the student structures the control flow (with loops and if statements), and structures the code by using and creating simple functions with parameters and returns. The student can apply this by creating a simple application using Python.</p>	
Learning outcomes	<p>Translate a delimited information question within a limited setting into a programmable problem within a given architecture. (1.1.3)</p> <p>Create the design of a delimited part of an app, application or information system using a given modelling technique. (2.1.3)</p> <p>Implement the application of a given algorithm or mathematical model of limited scope. (3.1.1)</p> <p>Build, test and deliver a prototype of an app, application or information system.(3.1.2)</p>	
Requirements for participation in units of study (See also Article 29 TER)		
Specific details	one	

### Assessment: Programming with Python 1 - 3718IT113A

Assessment	The student :
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objectives/criteria	<ul style="list-style-type: none"> <li>■ uses a proper lay-out and informative comment lines (3.1.2),</li> <li>■ understands what a variable is, what the type of a variable is, why typing is important and what soft typing means (3.1.2),</li> <li>■ understands what the scope of a variable is (3.1.2), <ul style="list-style-type: none"> <li>■ can construct a Nassi Schneidermann Diagram (NSD) or flow diagram from a given problem choosing the correct control structures and nesting the structures correctly (1.1.3).</li> <li>■ can translate NSD or flow diagram to Python functions and vice versa (3.1.1),</li> <li>■ uses control structures correctly in Python (2.1.3),</li> <li>■ correctly creates and uses functions (3.1.1),</li> </ul> </li> <li>■ understands and applies the division of responsibilities between functions (2.1.3),</li> <li>■ understands and correctly uses tuples, lists, sets and dictionaries in Python (3.1.2),</li> <li>■ knows how and where to find information on Python and can find and import Python libraries when needed (3.1.2).</li> </ul>	
Details of assessments	Written exam with open questions and a programming assignment to be completed during the exam session.	
Strategies and teaching activities	The contact hours are combined lectures with exercises and lab-sessions where the student will work on programming assignments.	
Compulsory attendance (See also Article 115 TER)	Yes	<p>Learning to program is a process where you need to practice, practice and practice. Feedback is vital and needs to be given in time. This is only possible when actively participating in the lab sessions.</p> <p>For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking. These criteria have been set at a minimum of 70%.</p> <p>By setting the criteria at 70% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences.</p>
Permitted aids	Computer, Python manuals, libraries and documentation.	

## Precalculus - 3714IT116Z

Content of unit of study	Starting this course has two aims. The first aim is to bridge the possible gap between high school mathematics and the level of mathematics used in the rest of study. The second aim is to accustom students from different nationalities to a common use of mathematical notation and language. To achieve this aim the following topics will be covered: basic algebra, first and second degree equations, logarithms and exponentials, trigonometry, long division, completing the square and drawing graphs of functions.
Learning outcomes	<p>Describe the types of problems that allow the use of a given mathematical model. (1.1.1)</p> <p>Define the constraints that the algorithm for a problem must meet. (1.1.2)</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Precalculus - 3714IT116A

Assessment objectives/criteria	<p>After completing this course the student:</p> <ul style="list-style-type: none"> <li>■ can analyse and can conduct computations with reasonable numeracy and accuracy</li> <li>■ can conduct computations with fractions and roots, with numbers and variables</li> <li>■ can factorize a polynomial and can conduct a long division of a polynomial with variables</li> <li>■ can recognize mathematical functions; the student can compute and apply properties of functions</li> </ul>
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	<ul style="list-style-type: none"> <li>can solve types of (systems of) equations and inequalities</li> <li>can compute and apply properties of simple trigonometric functions; the student can solve simple trigonometric equations</li> <li>can compute properties of logarithmic and exponential functions; the student can solve with these functions simple equations</li> </ul>	
Details of assessments	Written exam.	
Strategies and teaching activities	<p>Teaching method: tutorials, without calculator</p> <p>The teacher gives a short explanation of the theory, and explains homework questions</p> <p>The student practices problems during tutorials and makes homework according to the schedule, prepares questions for the teacher, practices with the trial exam</p> <p><b>Attendance is not mandatory, but is strongly recommended; the students responsibility is to keep track of treated theory, solved problems and instructions of the teacher</b></p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## Term 2

# Calculus 1 - 3714IT121Z

Content of unit of study	Every engineer must be able to apply the ideas of calculus in his later working career. In this course, the concepts of Derivative and Integration are introduced.	
Learning outcomes	<p>Describe the types of problems that allow the use of a given mathematical model. (1.1.1)</p> <p>Define the constraints that the algorithm for a problem must meet. (1.1.2)</p> <p>Tailor a simple given mathematical model to a problem. (2.1.1)</p> <p>Apply a given algorithm to a simple problem. (2.1.2)</p>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

## Assessment: Calculus 1 - 3714IT121A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>apply rules (product-, quotient- and chain rule) for differentiation of (quotients of) polynomials, trigonometric functions, exponential functions and logarithmic functions.</li> <li>apply rules (substitution, integration by parts, using partial fractions) for integration of (quotients of) polynomials, trigonometric functions, exponential functions and logarithmic functions.</li> <li>determine extreme values and inflection points of functions</li> <li>produce an equation of tangent and normal.</li> </ul>	
Details of assessments	Written exam	
Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115)	No	

TER)	
Permitted aids	None

## Programming with Python 2 - 3718IT122Z

Content of unit of study	This course continues on the course Python 1. This course will go into the more advanced features of programming in Python. Subjects covered are datatypes, input/output, an introduction to object orientation , errors and exceptions and the use of the tkinter library for GUIs.
Learning outcomes	Translate a delimited information question within a limited setting into a programmable problem within a given architecture (1.1.3). Create the design of a delimited part of an app, application or information system using a given modeling technique (2.1.3). Implement the application of a given algorithm or mathematical model of limited scope (3.1.1). Build, test and deliver a prototype of an app, application or information system (3.1.2).
Requirements for participation in units of study (See also Article 29 TER)	None, but it is advised to do Python 1 first.
Specific details	None

### Assessment: Programming with Python 2 - 3718IT122A

Assessment objectives/criteria	<p>The student</p> <ul style="list-style-type: none"> <li>■ uses informative comment lines (3.1.2),</li> <li>■ understands what a variable is, what the scope and type of a variable is, why typing is important and what soft typing means (3.1.2),</li> <li>■ can covert numbers from binary to hexadecimal to decimal and vice versa (1.1.3),</li> <li>■ understands applies correctly bitwise operations (2.1.3),</li> <li>■ understands utf-8 encoding (2.1.3),</li> <li>■ can construct a Nassi Schneidemann Diagram (NSD) or flow diagram from a given problem choosing the correct control structures and nesting the structures correctly (1.1.3).</li> <li>■ can translate NSD or flow diagram to Python functions and vice versa (3.1.1),</li> <li>■ correctly creates and uses functions (3.1.1),</li> <li>■ understands and correctly uses tuples, lists, dictionaries and sets in Python (3.1.2),</li> <li>■ knows how and where to find information on Python and can find and import modules when needed (3.1.2.).</li> <li>■ can open, close, read, write and append in text-files and in binary-files (3.1.2),</li> <li>■ understands the difference between errors and exceptions and creates code to handle exceptions effectively (3.1.2)</li> <li>■ understands the basics of object orientation and applies it correctly in Python (3.1.2)</li> </ul>	
Details of assessments	Programming assignment to be completed during the exam session.	
Strategies and teaching activities	The contact hours are combined lectures with exercises and lab-sessions where the student will work on programming assignments.	
Compulsory attendance (See also Article 115 TER)	Yes	Learning to program is a process where you need to practice, practice and practice. Feedback is vital and needs to be given in time. This is only possible when actively participating in the lab sessions. For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking.

	These criteria have been set at a minimum of 70%. By setting the criteria at 70% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences.
Permitted aids	Computer, Python manuals, libraries and documentation.

## Project Casual Graphics - 3718IT123Z

Content of unit of study	In this project you will develop an application in Python in a 4 - 5 member team setting. This first stepping stone project is divided in four phases: Idea, Proof of Concept, Alpha release, Beta release. It will address project skills (planning, deadlines, meetings, and releases), professional skills (communication, presenting or demonstrating results) and technical skills (software development, math).
Learning outcomes	<p>Translate a delimited information question within a limited setting into a programmable problem within a given architecture. (1.1.3)</p> <p>Tailor a simple given mathematical model to a problem. (2.1.1)</p> <p>Apply a given algorithm to a simple problem.(2.1.2)</p> <p>Create the design of a delimited part of an app, application or information system using a given modelling technique.(2.1.3)</p> <p>Implement the application of a given algorithm or mathematical model of limited scope. (3.1.1)</p> <p>Build, test and deliver a prototype of an app, application or information system. (3.1.2)</p> <p>Create, track and update a project plan. (5.1.2)</p> <p>Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies.(5.1.3)</p> <p>Consult effectively and efficiently with those involved.(5.1.4)</p> <p>Allocate and delegate tasks within a project.(5.1.5)</p> <p>Communicate effectively both orally and in writing.(6.1.2)</p> <p>Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background.(7.1.1)</p> <p>Provide solutions to encountered problems. (7.1.2)</p> <p>Describe the task, objectives, and scope of an assignment.(7.1.5)Collaborate effectively in an intercultural (project) team. (8.1.1)</p> <p>Reflect on own behaviour and give and receive feedback in an appropriate way.(8.1.2)</p> <p>Apply knowledge, insights and skills. (8.1.3)</p> <p>Demonstrate an appropriate (study) attitude. (8.1.4)</p> <p>Communicate effectively, both orally and in writing.(8.1.5)</p> <p>Contribute to a respectful study environment.(8.1.6)</p> <p>Work according to agreements and planning.(8.1.7)</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Project Casual Graphics - 3718IT123A

Assessment objectives/criteria	<p>The student can:</p> <ul style="list-style-type: none"> <li>■ Create, track and update a project plan (5.1.2)</li> <li>■ Manage a project and maintain process quality (5.1.3)</li> <li>■ Consult effectively and efficiently with those involved (5.1.4)</li> <li>■ Allocate and delegate tasks (5.1.5)</li> <li>■ Select and apply relevant sources (7.1.1)</li> </ul>
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	<ul style="list-style-type: none"> <li>■ Provide solutions to encountered problems (7.1.2)</li> <li>■ Describe the task, objective and scope of the assignment (7.1.5)</li> <li>■ Cooperate effectively in a (project)team (8.1.1)</li> <li>■ Reflect on own behavior and give and receive feedback appropriately (8.1.2)</li> <li>■ Apply knowledge, insights and skills (8.1.3) and demonstrate an appropriate study attitude (8.1.4)</li> <li>■ Communicate effectively (6.1.2),(8.1.5) and contribute to a respectful environment (8.1.6)</li> <li>■ Meet deadlines (8.1.7)</li> <li>■ Demonstrate the ability to deliver sufficient product quality using Python (3.1.2)</li> <li>■ Translate mathematical relations in coding and a graphic representation of a fractal (2.1.1), (3.1.1)</li> <li>■ Apply recursive functions and complex numbers (2.1.2)</li> <li>■ Build a simple application with user interaction giving a graphical representation of a fractal (1.1.3), (2.1.3)</li> </ul>	
Details of assessments	<p>Your final grade will be composed of a group product and process grade and an individual grade. In case of insufficient participation or not functioning of the project group the project can be resit in the next academic year.</p>	
Strategies and teaching activities	Workshops, project and tutor meetings	
Compulsory attendance (See also Article 115 TER)	Yes	<p>During a project, visible execution and performance of vital skills such as mutual cooperation, communication with and to stakeholders and giving and receiving feedback and acting accordingly upon as such, form part of the examining and grading. For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking. These criteria have been set at a minimum of 70%.</p> <p>By setting the criteria at 70% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences.</p> <p>These criteria have been explicitly stipulated for this project in the project description, leaving no room for ambiguous interpretations at the start of the project.</p>
Permitted aids	All available relevant sources	

## Professional skills 2 - 3719IT124Z

Content of unit of study	<p>Studying is far more than just gathering knowledge and getting a degree. En route towards the degree, acquiring certain skills and gaining a professional attitude are intertwined with your development into a professional.</p> <p>Within the University of Applied Sciences (Hbo) we mainly focus on acquiring 'competences'. In Holland uses the following definition of 'competences': 'the mental tools that allow you to execute various professional tasks. Apart from knowledge, it also means forming and developing skills, insight and attitude. Combined, this will provide the graduate with the ability to act adequately in critical professional situations, and to reflect upon this'</p> <p>Professional skills you learn how to manage your own study career. You learn to recognize and use your strong points, become aware of your limitations, and, as a result of this, know how to make your own plan of action. One of the lecturers of Information Technology will be assigned to be your study career coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>Professional skills is both an individual process and a group, collaborative process.</p>
Learning outcomes	<p>After successfully completing this module, the student is able to:</p> <ul style="list-style-type: none"> <li>8.1.1 Collaborate effectively in an intercultural (project) team.</li> <li>8.1.2 Reflect on own behaviour and give and receive feedback in an appropriate way.</li> <li>8.1.3 Apply knowledge, insights and skills.</li> <li>8.1.4 Demonstrate an appropriate (study) attitude.</li> </ul>



	8.1.5 Communicate effectively, both orally and in writing. 8.1.6 Contribute to a respectful study environment. 8.1.7 Work according to agreements and planning.
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

## Assessment: Professional skills 2 - 3719IT124A

Assessment objectives/criteria	<p>Written assignments:</p> <p><b>Components</b> - Accurately uses correct business letter format (heading, greeting, introduction, body, closure, signature, enclosure, and copy)</p> <p><b>Content</b> - Letter clearly states the purpose - uses Appropriate explanations or facts used to support the main idea "</p> <p><b>Appearance</b> - using correct spacing, font, and format and lay-out</p> <p><b>Language Usage</b> - Accurate use of punctuation and grammar, vocabulary at B1/B2 level, No spelling errors</p> <p>Class sessions and personal interviews are assessed on the following criteria:</p> <ul style="list-style-type: none"> <li>■ Demonstrating respect and responsibility when communicating with others (8.1.1)</li> <li>■ Demonstrating sensitivity to diverse cultures, audiences or contexts when working with others (8.1.2)</li> <li>■ Communicate effectively, both orally and in writing (8.1.5)</li> <li>■ Identifying interests, values or skills to set learning, life or career goals (8.1.3)</li> <li>■ Exploring, selecting or adapting strategies and resources that support personal growth in life, school or career pathways (8.1.4, 8.1.6 and 8.1.7)</li> </ul>	
Details of assessments	<p>Written assignments and class sessions</p> <p>Furthermore consultation with coach with respect to study progress.</p>	
Strategies and teaching activities	<p>The instructional format and educational activities consist of 7 x 2 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; written assignments and consultation with coach regarding study progress.</p>	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	N/A	

## Statistics 1 - 3719IT125Z

Content of unit of study	<p>Data is becoming more and more important in our society. Huge amounts of data are collected every day. Companies keep track of their orders, schools monitor their students, and researchers store their measurements. To turn all these data into meaningful information, they need to be organized and analyzed. The branch of mathematics that covers methods necessary for analyzing data and drawing valid conclusion is called Statistics.</p> <p>The course Statistics 1 focuses on descriptive statistics: summarizing data and visualizing it in tables and graphs. It also addresses analysis of the relation between variables through linear regression. The course covers the theory as well as the use of statistical modules in Python. It builds on Precalculus and Python 1 and prepares for the advanced courses on statistics and data science.</p>
Learning outcomes	<p>Describe the types of problems that allow the use of a given mathematical model. (1.1.1)</p> <p>Determine the main properties of a given data set. (1.1.5)</p> <p>Apply a given algorithm to a simple problem (2.1.2)</p>



	Select suitable methods for descriptive analysis of a data set. (2.1.5) Create and deliver a descriptive model of a data set. (3.1.4)
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	

### Assessment: Statistics 1 - 3719IT125A

Assessment objectives/criteria	After successfully completing this module, the student is able to: <ul style="list-style-type: none"> <li>- Explain the basic goals and concepts of statistics;</li> <li>- Describe advantages and disadvantages of various data collection methods;</li> <li>- Create an appropriate graphical representation of a data set;</li> <li>- Compute descriptive statistics for a data set;</li> <li>- Perform a linear regression analysis on two variables;</li> <li>- Use Python for descriptive statistics.</li> </ul>	
Details of assessments	Assessment is based on a written exam and a programming assignment.	
Strategies and teaching activities	Lectures, exercises, and practical work	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	Calculator	

### Term 3

## Research 1 - 3720IT131Z

Content of unit of study	<p>In any but the simplest situations, you need to think before you can create something. It may not always be clear what the problem is, it may not be clear what the solution is. But it can run deeper; there may be — obvious or not so obvious — alternatives to be considered.</p> <p>A great risk when faced with a question is that the solution seems to be easy, leading the engineer to implement it without considering all aspects of the situation. This may lead to an unsustainable solution, does not give the best way to solve the problem, turns out to be the wrong answer, or is ethically unacceptable.</p> <p>During this introductory course in applied research, you will learn a structured way to solve a problem. You will also start the road to a scientific way of reasoning in solving practical problems and build some understanding of the ethical aspects which may be involved.</p>	
Learning outcomes	Professionalisation 8.1.4 Demonstrate an appropriate (study) attitude. Research 7.1.1 Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background. 7.1.2 Provide solutions to encountered problems. 7.1.3 Select and apply a suitable research method. 7.1.4 Write a research proposal and/or research plan. 7.1.5 Describe the task, objectives, and scope of an assignment. 7.1.6 Use correct and complete referencing to sources in a report.	

	7.2.6 Formulate a relevant research question and subquestions for a research study.
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Research 1 - 3720IT131A

Assessment objectives/criteria	After successfully completing this module, the student is able to: <ul style="list-style-type: none"> <li>Describe and identify the phases in a structured applied research</li> <li>Create a summarized plan for each phase in a given, structured research situation</li> <li>Use a scientifically sound way of reasoning to draw or reject a conclusion</li> <li>Identify the kind of scientific reasoning needed or neglected in a given situation</li> <li>Assess the ethical implications in a research proposal and give your reasoned opinion on it.</li> </ul>	
Details of assessments	A full written exam covering all topics is given in the exam week.	
Strategies and teaching activities	There will be one class a week. During this, the theme or subjects of that week are introduced and discussed using a multitude of sources.	
Compulsory attendance (See also Article 115 TER)	Yes	Attendance is necessary in order to do the tests described under 'Details of assessments'. No resits are given for those partial tests.
Permitted aids	None	

## DBMS 1 - 3720IT134Z

Content of unit of study	Companies, governments, schools and all kinds of institutions have data. This data is stored in so called database management systems (DBMS). In this course an introduction is given in the structure of databases and how to retrieve information from them by using the language SQL. Also attention will be given on how to insert new data, delete data or modify existing information. Finally the topic of how to maintain logical consistency in the database will be covered.	
Learning outcomes	Translate a delimited information question within a limited setting into a programmable problem within a given architecture. (1.1.3) Analyse the data requirements for a given application of limited scope. (1.1.4) Determine the main properties of a given data set.(1.1.5)	
Requirements for participation in units of study (See also Article 29 TER)	none	
Specific details		

### Assessment: DBMS 1 - 3720IT134A

Assessment objectives/criteria	After completing this course the student; <ul style="list-style-type: none"> <li>can analyze a relational database diagram</li> <li>is able to write a SQL query to retrieve desired information from the database</li> </ul>	
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	<ul style="list-style-type: none"> <li>is able to write a SQL command to insert, update or delete data from the database</li> <li>understands the concept of logical integrity</li> </ul>	
Details of assessments	A written exam in which the student will have to write specific queries.	
Strategies and teaching activities	Theory will be explained by the teacher, immediately followed by exercises.	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	MySQL database	

## Linear Algebra - 3719IT133Z

Content of unit of study	Linear Algebra helps you to understand more dimensions. Solving linear equations and mappings can be done by the theory of Linear Algebra. This course will introduce Vectors and Matrices. Basic topics are: Determinants, Inverse, and Eigenvalue. Some of the operations will be programmed in Python.	
Learning outcomes	Describe the types of problems that allow the use of a given mathematical model. (1.1.1) Define the constraints that the algorithm for a problem must meet. (1.1.2) Tailor a simple given mathematical model to a problem. (2.1.1) Apply a given algorithm to a simple problem. (2.1.2) Implement the application of a given algorithm or mathematical model of limited scope. (3.1.1) Build, test and deliver a prototype of an app, application or information system. (3.1.2)	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

### Assessment: Linear Algebra - 3719IT133A

Assessment objectives/criteria	The student can: <ul style="list-style-type: none"> <li>Calculate operations for Matrices and its Determinant</li> <li>Solve linear equations by using Matrices and/or Determinants</li> <li>Calculate operations for Vectors</li> <li>Solve simple Eigenvalue problems</li> <li>Apply the use of matrices in a python program</li> </ul>	
Details of assessments	Written Exam and a programming assignment during the term.	
Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	None	

## English 2 - 3713IT144Z

Content of unit of study	<p>During the English courses the emphasis will be on reading, writing, listening, speaking and communicating. The courses start with an emphasis on acquiring new English vocabulary (formal vs informal), reviewing English grammar and will subsequently focus on speaking and writing. Especially writing will be the focus of attention and be presented in the form of letters, memos, research essays and reports. These assignments will be spread out over the 5 modules of English given in years 1 and 2. Developing professional English skills prepares the student not only for the final thesis, but also for the professional work field.</p> <p>English 2: this course aims at bringing your reading level up to C1 and level of writing to level B2.</p>
Learning outcomes	8.1.5 Communicate effectively, both orally and in writing.
Requirements for participation in units of study (See also Article 29 TER)	None.
Specific details	Prerequisites: Having successfully completed ENG1 is preferred. Students are expected to have full knowledge of all aspects dealt with in this course

### Assessment: English 2 - 3713IT144A

Assessment objectives/criteria	<ul style="list-style-type: none"><li>■ Assessment criteria:<table><tr><td>Formatting</td><td>Contains all components of assignment and is of appropriate length. Includes accurate heading with to/from/date/subject clearly stated.</td></tr><tr><td>Content</td><td>Problem is explained with suitable level of detail. Model is applied (good News vs bad news) Resolution included, with clear responsibilities assigned. Context and history of the problem are given as needed.</td></tr><tr><td>Grammar &amp; Proofreading</td><td>Displays proper usage of formal, grammatical English. Shows evidence of careful proofreading.</td></tr></table></li></ul>		Formatting	Contains all components of assignment and is of appropriate length. Includes accurate heading with to/from/date/subject clearly stated.	Content	Problem is explained with suitable level of detail. Model is applied (good News vs bad news) Resolution included, with clear responsibilities assigned. Context and history of the problem are given as needed.	Grammar & Proofreading	Displays proper usage of formal, grammatical English. Shows evidence of careful proofreading.
Formatting	Contains all components of assignment and is of appropriate length. Includes accurate heading with to/from/date/subject clearly stated.							
Content	Problem is explained with suitable level of detail. Model is applied (good News vs bad news) Resolution included, with clear responsibilities assigned. Context and history of the problem are given as needed.							
Grammar & Proofreading	Displays proper usage of formal, grammatical English. Shows evidence of careful proofreading.							
Details of assessments	Written assignment without a formal test sitting. In class presentation (P/F)							
Strategies and teaching activities	The instructional format and educational activities consist of 7 x 4 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; an in-term presentation which forms part of the final grade, followed by an individual exam (written assignment)							
Compulsory attendance (See also Article 115 TER)	Yes							
Permitted aids	Individual papers – written outside of class - aids and sources permitted. Presentation: to be decided by student(s). (PowerPoint, Prezi, other)							

## Statistics 2 - 3720IT135Z

Content of unit of	In the first part of this course the focus will lie on probability theory. It will start with the basic axioms of
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study	probability such as the addition rule and multiplication rule, eventually covering more advanced topics such as Bayes rule, the binomial distribution and the Poisson distribution. The second part of this course will cover sampling theory. Topics such as the mean and standard deviation of a sample will be covered, as well as advanced topics such as confidence intervals, Student's t-distribution and the Chi square distribution. This course will build upon what has been learned in Statistics 1.
Learning outcomes	Describe the types of problems that allow the use of a given mathematical model. (1.1.1) Define the constraints that the algorithm for a problem must meet. (1.1.2) Tailor a simple given mathematical model to a problem. (2.1.1) Apply a given algorithm to a simple problem. (2.1.2)
Requirements for participation in units of study (See also Article 29 TER)	none
Specific details	

### Assessment: Statistics 2 - 3720IT135A

Assessment objectives/criteria	After successfully completing this module, the student is able to: Calculate discrete probability outcomes for a variety of situations. Apply the normal distribution in calculating probabilities. Apply the Poisson distribution in calculating probabilities. Describe the distribution of the sample mean and sample proportion. Construct confidence intervals for population proportions, population means and population standard deviations.	
Details of assessments	The exam will consist of 5 or 6 questions about the theory learned.	
Strategies and teaching activities	Classical explanation of the theory, together with classical problem solving.	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	electronic calculator	

## ME learning challenge 1 - 3720IT136Z

Content of unit of study	<p>The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education in this field is never complete. To keep up with the latest developments, a mathematical engineer must be able to direct their own learning process throughout their career.</p> <p>During the ME Learning Challenge students have the opportunity to shape their own learning process by delving into a topic of their choice. Students are encouraged to pursue their own interests and ambitions.</p> <p>The Learning Challenge is a one-week intensive course for students from years 1 and 2. Before the course starts, students indicate which topics they would like to work on. Students are free to suggest any topics that are related to the ME competencies, but that are not part of the core curriculum. Based on their preferences the teachers assign students to a learning team and a topic. Learning teams can consist of students from different levels. During the course week, students from the team work together on learning the topic. Students choose their own educational resources, make a work plan, and guide their own learning. Teachers are available for assistance in the role of learning coaches. At the end of the week, students present the outcomes of their learning in a suitable way to the coaches and peers.</p>

Learning outcomes	<ul style="list-style-type: none"> <li>■ Create, track and update a project plan. (5.1.2)</li> <li>■ Consult effectively and efficiently with those involved. (5.1.4)</li> <li>■ Collaborate effectively in an intercultural (project) team. (8.1.1)</li> <li>■ Reflect on own behaviour and give and receive feedback in an appropriate way. (8.1.2)</li> <li>■ Demonstrate an appropriate (study) attitude. (8.1.4)</li> <li>■ Communicate effectively, both orally and in writing. (8.1.5)</li> <li>■ Contribute to a respectful study environment. (8.1.6)</li> <li>■ Work according to agreements and planning. (8.1.7)</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: ME learning challenge 1 - 3720IT136A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Define learning objectives for a learning task.</li> <li>■ Select suitable educational resources.</li> <li>■ Create a work plan for a learning task.</li> <li>■ Effectively develop professional competences at their study level by working according to a work plan.</li> <li>■ Collaborate effectively in a learning team.</li> <li>■ Communicate effectively with coaches and members of a learning team.</li> <li>■ Present the outcomes of a learning process.</li> <li>■ Reflect critically on the applied learning methods and learning process.</li> </ul>
Details of assessments	
Strategies and teaching activities	Students study in a learning team coached by lecturers.
Compulsory attendance (See also Article 115 TER)	Yes
Permitted aids	All

## Term 4

### Project Databases - 3719IT141Z

Content of unit of study	In this project you will develop an application in MySQL and Python in a 4 - 5 member team setting. This first stepping stone project is divided in four phases: Database design, Feature list, Alpha release, Beta release. It will address project skills (planning, deadlines, meetings, and releases), professional skills (communication, presenting or demonstrating results) and technical skills (DBMS and software development).
Learning outcomes	<p>Translate a delimited information question within a limited setting into a programmable problem within a given architecture. (1.1.3)</p> <p>Analyse the data requirements for a given application of limited scope. (1.1.4)</p> <p>Determine the main properties of a given data set. (1.1.5)</p> <p>Create the design of a delimited part of an app, application or information system using a given modelling technique. (2.1.3)</p> <p>Create a data model. (2.1.4)</p>

	Select suitable methods for descriptive analysis of a data set. (2.1.5) Build, test and deliver a prototype of an app, application or information system. (3.1.2) Build, test and deliver a database. (3.1.3) Create and deliver a descriptive model of a data set. (3.1.4) Create technical documentation for a developed information system. (4.1.2) List and select project methods and software development methods.(5.1.1) Create, track and update a project planning (5.1.2) Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies. (5.1.3) Consult effectively and efficiently with those involved (5.1.4) Allocate and delegate tasks within a project (5.1.5) Verify and substantiate a given recommendation. (6.1.1) Communicate effectively both orally and in writing. (6.1.2) Create an advisory report according to the guidelines, under supervision. (6.1.3) Select and apply relevant sources (7.1.1) Provide solutions to encountered problems (7.1.2) Describe the task, objective and scope of the assignment (7.1.5) Cooperate effectively in a (project)team (8.1.1)
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	

### Assessment: Project Databases - 3719IT141A

Assessment objectives/criteria	After completing this project the student is able to: <ul style="list-style-type: none"> <li>■ Create a datamodel of a real life process</li> <li>■ create a database that reflects the datamodel</li> <li>■ create an application built in Python</li> <li>■ communicate effectively in spoken word and text in a group and with a customer</li> </ul>	
Details of assessments	Your final grade will be composed of a group product and process grade and an individual grade. In case of insufficient participation or not functioning of the project group the project can be re-sit in the next academic year.	
Strategies and teaching activities	Workshops, project and tutor meetings	
Compulsory attendance (See also Article 115 TER)	Yes	During a project, visible execution and performance of vital skills such as mutual cooperation, communication with and to stakeholders and giving and receiving feedback and acting accordingly upon as such, form part of the examining and grading. For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking. These criteria have been set at a minimum of 70%. By setting the criteria at 70% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences. These criteria have been explicitly stipulated for this project in the project description, leaving no room for ambiguous interpretations at the start of the project.
Permitted aids	All available relevant sources	

## Professional skills 3 - 3719IT142Z

Content of unit of study	Studying is far more than just gathering knowledge and getting a degree. En route towards the degree, acquiring certain skills and gaining a professional attitude are intertwined with your development into a professional.
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	<p>Within the University of Applied Sciences (Hbo) we mainly focus on acquiring 'competences'. Inholland uses the following definition of 'competences': 'the mental tools that allow you to execute various professional tasks. Apart from knowledge, it also means forming and developing skills, insight and attitude. Combined, this will provide the graduate with the ability to act adequately in critical professional situations, and to reflect upon this.</p> <p>In Professional skills you learn how to manage your own study career. You learn to recognize and use your strong points, become aware of your limitations, and, as a result of this, know how to make your own plan of action. One of the lecturers of Information Technology will be assigned to be your study career coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>Professional skills is both an individual process and a group, collaborative process.</p>
Learning outcomes	<p>After successfully completing this module, the student is able to:</p> <p>8.1.1 Collaborate effectively in an intercultural (project) team.</p> <p>8.1.2 Reflect on own behaviour and give and receive feedback in an appropriate way.</p> <p>8.1.4 Demonstrate an appropriate (study) attitude.</p> <p>8.1.6 Contribute to a respectful study environment.</p> <p>8.1.7 Work according to agreements and planning.</p>
Requirements for participation in units of study (See also Article 29 TER)	No
Specific details	None

### Assessment: Professional skills 3 - 3719IT142A

Assessment objectives/criteria	<p>The class sessions, written assignments and personal interviews are assessed on the following criteria:</p> <ul style="list-style-type: none"> <li>■ Demonstrating respect and responsibility when communicating with others (8.1.1)</li> <li>■ Demonstrating sensitivity to diverse cultures, audiences or contexts when working with others (8.1.2)</li> <li>■ Exhibiting reciprocity and trust when sharing ideas or roles (8.1.2)</li> <li>■ Exploring, selecting or adapting strategies and resources that support personal growth in life, school or career pathways (8.1.6 and 8.1.7)</li> </ul>	
Details of assessments	<p>Written assignments and class sessions</p> <p>Furthermore consultation with coach with respect to study progress</p>	
Strategies and teaching activities	<p>The instructional format and educational activities consist of both group and individual sessions. In the group sessions an introduction to the assignments will be given and the study planning discussed. In the individual sessions the handed in assignments and the study progress will be discussed with the mentor.</p>	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	None	

## DBMS 2 - 3714IT143Z

Content of unit of study	Data are facts, in themselves and without context without meaning. Combining them gives information, facts in context conveying meaning. Nowadays, information is the lifeblood of most if not all organizations.
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	Databases are widely used to organize and store structured data and retrieve information. In this course, students will learn the basics of information analysis and the models used in doing one. The main part of the course will focus on how to convert the results of an information analysis into the necessary logical and physical models, implement these in a database, and optimize this database for the expected usage. Part of this is writing triggers and stored procedures to support the retrieval of complex information and to keep the database consistent.
Learning outcomes	Analyse the data requirements for a given application of limited scope. (1.1.4) Create a data model (2.1.4) Build, test and deliver a database (3.1.3) Use management protocols and systems for data management. (4.1.3)
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: DBMS 2 - 3714IT143A

Assessment objectives/criteria	After successfully completing this module, the student is able to: <ul style="list-style-type: none"> <li>■ Create a simple data model given a clear context and information need</li> <li>■ Transform the results of this information analysis to a database design</li> <li>■ Optimize the database design in terms of consistency and performance</li> <li>■ Implement the database design in the MySQL DBMS</li> <li>■ Write MySQL triggers and stored procedures to support the usage of the database</li> <li>■ Connect the database with a programming language and fire queries at it.</li> </ul>	
Details of assessments	The exam consists of a written part on database design, and a practical part done on the computer.	
Strategies and teaching activities	Instructions followed by exercises and lab sessions.	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	A computer running the MySQL DBMS, manuals and documentation.	

## Statistics 3 - 3719IT144Z

Content of unit of study	Statistics are often used to substantiate a claim. For instance, based on a poll of 50 students, we may conclude that students from year 1 tend to spend more time at school than students from year 2. However, as these conclusions are based on a sample, we cannot be certain that they also hold for the whole student population. To judge the plausibility of a claim, hypothesis testing can be used. Hypothesis testing is a structured procedure to test statements about a population based on sample evidence and probability. It allows us to calculate how likely it is that a statement does or does not hold for the population. This course covers the basic principles of hypothesis testing as well as a range of specific hypothesis tests. Students learn to select the right test for a real-world problem and to apply the test to the data. The course builds upon the concepts learned in the courses Statistics 1 and 2.
Learning outcomes	Tailor a simple given mathematical model to a problem. (2.1.1) Apply a given algorithm to a simple problem. (2.1.2) Implement the application of a given algorithm or mathematical model of limited scope. (3.1.1)

Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	Calculator

### Assessment: Statistics 3 - 3719IT144A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Select an appropriate hypothesis test for a problem.</li> <li>■ Conduct a hypothesis test on one sample.</li> <li>■ Conduct a hypothesis test on two samples.</li> <li>■ Conduct a hypothesis test on categorical data.</li> <li>■ Conduct a hypothesis test on three or more means.</li> <li>■ Conduct a nonparametric hypothesis test.</li> <li>■ Interpret the meaning of a hypothesis test in the context of the original problem</li> </ul>	
Details of assessments		
Strategies and teaching activities	Lectures and exercises	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	Calculator	

## Calculus 2 - 3714IT136Z

Content of unit of study	CCalculus 2 builds on the concepts of Calculus 1. The type of numbers will be extended by the Complex numbers, so more equations can be solved. Sequences and Series is a new topic. Differential equations will apply the topics of differentiation and integration. Functions of more than one variable complete Calculus 2.	
Learning outcomes	Describe the types of problems that allow the use of a given mathematical model. (1.1.1) Define the constraints that the algorithm for a problem must meet.(1.1.2) Tailor a simple given mathematical model to a problem. (2.1.1) Apply a given algorithm to a simple problem. (2.1.2)	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

### Assessment: Calculus 2 - 3714IT136A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Using Complex numbers for solving equations</li> <li>■ Solving simple Sequences and Series problems</li> <li>■ Solving first and second order Differential equations</li> <li>■ Solving simple problems with Functions of more than one variable</li> <li>■ Analyzing and Finding a solution for Calculus problems with software products</li> </ul>	
Details of assessments	Written Exam	

Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## Year 2

### Basic curriculum

#### Term 1

## English 3 - 3719IT212Z

Content of unit of study	During the English courses the emphasis will be on reading, writing, listening, speaking and communicating. The courses start with an emphasis on developing English vocabulary at level C1 and will subsequently focus on speaking and writing. Especially writing will be the focus of attention and be presented in the form of a research reports in order to prepare the student not only for the final thesis, but also for the professional work field. The courses aims at level B2 of the CEFR for spoken English.
Learning outcomes	8.1.5 Communicate effectively, both orally and in writing.
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	Prerequisites: the level of English should at least be at B2 but preferably C1, of the CEFR (Common European Framework for References of Languages).

### Assessment: English 3 - 3719IT212A

Assessment objectives/criteria	<p><b>Assessment criteria</b></p> <p><b>Criterion A: Use a process journal</b></p> <ul style="list-style-type: none"> <li>■ demonstrate organizational skills showing time- and self-management</li> <li>■ communicate and collaborate with the supervisor</li> <li>■ demonstrate information literacy, thinking and reflection.</li> </ul> <p><b>Criterion B: Define the goal</b></p> <ul style="list-style-type: none"> <li>■ identify and explain a topic based on personal interest/Web Science topic</li> <li>■ justify one focus area of interaction as a context for the project</li> <li>■ outline a clear, achievable, challenging goal</li> </ul> <p><b>Criterion C: Select sources</b></p> <ul style="list-style-type: none"> <li>■ select varied, relevant sources to achieve the goal</li> <li>■ evaluate sources.</li> </ul> <p><b>Criterion D: Apply information</b></p> <ul style="list-style-type: none"> <li>■ transfer and apply information to make decisions, create solutions and develop understandings in connection with the project's goal.</li> </ul> <p><b>Criterion E: Achieve the goal</b></p> <ul style="list-style-type: none"> <li>■ evaluate the outcome/product against specifications for success.</li> </ul> <p><b>Presentation</b></p>
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	<b>Assessment criteria</b> The presentation is assessed on the following criteria: <ol style="list-style-type: none"> <li>1. Used aids in media, such as PowerPoint, Prezi, Rocket Slide etc., attractiveness of the presentation</li> <li>2. Topic, complexness or execution of the assignment</li> <li>3. Pronunciation</li> <li>4. Structured presentation: introduction, body, conclusion, sign-posting, presentation techniques, attitude in front of the class, meeting conventions for presentations</li> <li>5. Interaction with class during questions</li> </ol>	
Details of assessments	Written assignment without a formal test sitting. In class presentation (P/F)	
Strategies and teaching activities	The instructional format and educational activities consist of 7 x 4 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; an in-term presentation which forms part of the final grade, followed by an individual exam (written assignment)	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Individual paper – written outside of class aids and sources permitted. Presentation: to be decided by student(s). (PowerPoint, Prezi, other)	

## Object Oriented Programming 1 - 3719IT213Z

Content of unit of study	<p>In year 1 students learned the basics of programming structures using the programming language Python. These basics are sufficient for small applications handling small amounts of data. In order to develop more serious applications handling large amounts of data with complicated algorithms more tools and techniques are needed however.</p> <p>During this course, a start will be made with one of the most powerful tools available for developing this kind of programs: object orientation. In object orientation, the problem at hand is divided into smaller 'objects' with a certain degree of independency. There is no main program; instead, the objects will cooperate to achieve the goal.</p> <p>No matter how well programmed your code is, if the documentation is lacking, its usefulness is limited. And as code becomes more complicated, it needs to have a stronger and more insightful design and architecture to allow it to be implemented well. Part of this course therefore is about designing your code first using UML Class Diagrams and adding annotations to the code so technical documentation can be generated.</p>	
Learning outcomes	1.2.3 Translate an information question into a programmable problem within a given architecture. 2.2.3 - Design an app, application or information system, selecting a suitable modelling technique. 3.2.1 Implement the application of a designed algorithm or mathematical model of limited scope. 3.2.2 - Build, test and deliver (an extension to) an existing app, application or information system. 4.1.2 - Create technical documentation for a developed information system.	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details		

### Assessment: Object Oriented Programming 1 - 3719IT213A

Assessment	After successfully completing this module, the student is able to:
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objectives/criteria	<ul style="list-style-type: none"> <li>■ Use Java Reflection to fulfill a non-standard information need (1.2.3)</li> <li>■ Translate a design documented in UML into working Java code (3.2.1)</li> <li>■ Apply Java constructs in creating a basic application (3.2.2)</li> <li>■ Use both basic and advanced OO concepts in developing desktop software (3.2.2)</li> <li>■ Design classes according to industry-standard guidelines (2.2.3)</li> <li>■ Create technical documentation for your implemented code (4.1.2)</li> </ul>	
Details of assessments	This course will be examined by a computer exam. In this exam, students will program a (small) application containing the techniques learned.	
Strategies and teaching activities	<p>There are two classes a week, where theory and practice will be mixed. Theory will be explained and supported by on-the-fly examples using Eclipse. Several classes will use the Reflection API to solidify understanding of the underlying principles. Using the Reflection API is also part of the exam.</p> <p>Any decent application needs forethought. Throughout the course this will be supported by learning how to draw UML Class Diagrams.</p> <p>Most of the time spent in class is meant for supported exercise, as learning to develop software means practicing a lot.</p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All (online) literature permitted, as long as this does not constitute academic misconduct.	

## Statistics 4 - 3719IT214Z

Content of unit of study	<p>Many real-life data sets consist of multiple variables. For example, a weather data set may contain for each day the average temperature, the total precipitation, and the average wind speed. Such multidimensional data enables us to study the relation between the variables.</p> <p>The course Statistics 4 focusses on techniques for assessing the relation between variables. It covers inference on linear regression, multiple regression, logistic regression, and principle component analysis.</p>	
Learning outcomes	Analysis, Design, Implementation	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details		

### Assessment: Statistics 4 - 3719IT214A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Verify the conditions of linear, multiple, and logistic regression models.</li> <li>■ Build linear, multiple, and logistic regression models by means of statistical software.</li> <li>■ Apply variable selection for building multiple regression models.</li> <li>■ Conduct inference on linear, multiple, and logistic regression models.</li> <li>■ Interpret estimated coefficients in linear, multiple, and logistic regression models.</li> <li>■ Understand the working of principle component analysis.</li> <li>■ Apply principal component analysis by means of statistical software.</li> <li>■ Interpret the results of principle component analysis.</li> </ul>	
Details of assessments		
Strategies and	Instructions, exercises, and lab sessions	

teaching activities Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Calculator	

## Professional skills 4 - 3719IT215Z

Content of unit of study	<p>In Professional Skills you learn how to manage your own study career. One of the lecturers of Mathematical Engineering will be assigned to be your study coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>The course in this semester will focus on competency development and related to your competency development, the planning for your study in the coming years. What do you need for an effective internship and what are the options for minors and which minors will you choose and why?</p> <p>We will also reflect on the moral/ethical/legal aspects of big data.</p>	
Learning outcomes	<ul style="list-style-type: none"> <li>▪ Directs and substantiates the development of personal professional competencies, using input such as feedback and self-reflection. (8.2.2)</li> <li>▪ Demonstrate an appropriate professional attitude. (8.2.4)</li> </ul>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details		

### Assessment: Professional skills 4 - 3719IT215A

Assessment objectives/criteria	<p>The student:</p> <ul style="list-style-type: none"> <li>▪ Describes one of the competences of the program Mathematical Engineering in relation to the students development.</li> <li>▪ Reflects on the competencies by planning internship and minors.</li> <li>▪ Reflects on moral/ethical/legal aspects of big data.</li> </ul>	
Details of assessments	Written assignments	
Strategies and teaching activities	Instructions, presentations and group discussions as well as individual meetings.	
Compulsory attendance (See also Article 115 TER)	Yes	Individual sessions and presentations have compulsory attendance
Permitted aids	n.a.	

## Geometry - 3713IT223Z

Content of unit of study	Geometry is part of our real life. So it must be part of the Mathematical Engineer too. Many algorithms make use of Geometry, and many real world problems can only be solved in IT with Geometry. The class gives the student an introduction in the four different views of Geometry.
Learning outcomes	<ol style="list-style-type: none"> <li>1. 1.2.1 Analyse a problem using mathematical models.</li> <li>2. 2.2.1. Tailor a complex given mathematical model to a problem.</li> </ol>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Geometry - 3713IT223A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Solving Geometric problems by construction with straightedge and compass</li> <li>■ Applying Euclid's approach to solve Geometric problems</li> <li>■ Solving Geometric problems by coordinates</li> <li>■ Applying Vectors to solve Geometric problems</li> <li>■ Solving Geometric problems by projective geometry</li> </ul>	
Details of assessments	Written Exam	
Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Straightedge ( Ruler ), Pair of Compasses	

## Term 2

### Object Oriented Programming 2 - 3719IT222Z

Content of unit of study	<p>In year 1 students learned the basics of programming structures using the programming language Python. These basics are sufficient for small applications handling small amounts of data. Serious applications handling large amounts of data with complicated algorithms are developed with more powerful tools and techniques however.</p> <p>Object Oriented Programming 1 started with the concepts of object orientation and its design and implementation using Java. After finishing that course, students are expected to be able to implement, document and deploy simple Java applications</p> <p>During this course, we will expand on the knowledge from OOP1 and introduce several of the most powerful advanced features of Java: Generics and the Collections Framework. After that time will be spent on learning how to create a full-fledged Graphical User Interface with the JavaFX framework.</p> <p>After successfully finishing this module, the student will be able to create a fully functional Java application with a graphical user interface.</p>	
Learning outcomes	2.2.3 - Design an app, application or information system, selecting a suitable modelling technique.	

	2.3.3 - Design an app, application or information system suited to the existing or desired environment. 3.2.1 - Implement the application of a designed algorithm or mathematical model of limited scope. 3.2.2 - Build, test and deliver (an extension to) an existing app, application or information system.
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	

## Assessment: Object Oriented Programming 2 - 3719IT222A

Assessment objectives/criteria	After successfully completing this module, the student is able to: <ul style="list-style-type: none"> <li>■ Design an application in a way fitting with the purpose and environment of it (2.2.3)</li> <li>■ Apply Design Patterns to make an application maintainable (2.3.3)</li> <li>■ Use the Collections framework and Generics and adapt it to the specific needs (3.2.1)</li> <li>■ Create a functional GUI with JavaFX (3.2.2)</li> </ul>	
Details of assessments	Three assignments are given during the term, which have to be finished before the end of the first exam week. Each assignment counts for 1/3 of the final grade. It is possible for assignments to be combined into one document.  Some topics covered are not tested using an explicit assignment, but are interwoven through the assignments given.	
Strategies and teaching activities	Classes usually starts with an explanation of the subject for that day, supported by small code examples if deemed useful. After this introduction, students practice using the exercises in the Exercise Manual, getting support and feedback from the teacher.	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All (online) literature permitted, as long as this does not constitute academic misconduct.	

## Project Application Development - 3713IT221Z

Content of unit of study	<p>An important application of mathematical engineering is building a model of a real-life situation in order to make predictions and find desirable solutions to a problem. There usually are several approaches in tackling this kind of problems. For complicated situations, creating and implementing a mathematical model is one option, one which a bachelor in Mathematical Engineering should be able to use.</p> <p>Even when choosing to create a mathematical model, several approaches remain viable. The engineer needs to choose between the options available, and if deemed necessary do a preliminary research to decide. The question which option is best cannot generally be answered, as it depends on the specific circumstances. In this project, one of those real-life situations will be examined from several angles, as to gain some understanding of the way this kind of problems can be tackled.</p> <p>In this project, you will work in a project group of about five students on a real-life problem. The problem itself is made clear by the client; the project group needs to decide the approach they will use to answer the research question. Each group will use a different approach and near the end, the groups compare their results and draw a conclusion on the pros and cons of all angles and decide what would be the best way to actually answer the research question.</p> <p>It cannot be stressed enough that the purpose of this project is not so much answering the question of the client, but determining the best way to proceed answering it.</p>
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Learning outcomes	<p>1.2.1 Analyse a problem using mathematical models.</p> <p>1.2.3 Translate an information question into a programmable problem within a given architecture.</p> <p>2.2.1 Tailor a complex given mathematical model to a problem.</p> <p>2.2.3 Design an app, application or information system, selecting a suitable modelling technique.</p> <p>3.2.1 Implement the application of a designed algorithm or mathematical model of limited scope.</p> <p>3.3.2 Build, test and deliver an app, application or information system that fits within the existing or desired environment.</p> <p>4.1.1 Set up and use a control system to support software development in a team setting.</p> <p>4.1.2 Create technical documentation for a developed information system.</p> <p>5.1.1 List and select project methods and software development methods.</p> <p>5.1.2 Create, track and update a project plan.</p> <p>5.1.3 Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies.</p> <p>5.1.4 Consult effectively and efficiently with those involved.</p> <p>5.1.5 Allocate and delegate tasks within a project.</p> <p>6.2.1 Create a recommendation based on substantiated arguments.</p> <p>6.2.2 Communicate effectively, both orally and in writing, with people of various ranks.</p> <p>6.2.3 Create an advisory report according to the guidelines.</p> <p>7.2.1 Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background.</p> <p>7.2.2 Provide multiple solutions to encountered problems and make an informed choice for a solution.</p> <p>7.2.3 Select a method for determining the effectiveness of a chosen solution.</p> <p>7.2.4 Write and adapt a research proposal and/or research plan taking the interests of multiple stakeholders into account.</p> <p>7.2.5 Analyse requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment.</p> <p>7.2.6 Formulate a relevant research question and subquestions for a research study.</p> <p>8.2.1 Collaborate effectively in an intercultural (project) team in a setting with multiple stakeholders.</p> <p>8.2.2 Direct and substantiate the development of personal professional competencies.</p> <p>8.2.3 Apply knowledge, insights and skills and transfer these to others.</p> <p>8.2.4 Demonstrate an appropriate professional attitude.</p> <p>8.2.5 Communicate effectively with multiple stakeholders in an intercultural environment.</p> <p>8.2.6 Contribute to a safe and respectful work environment.</p> <p>8.2.7 Operate in critical situations in an independent and stress-free manner.</p> <p>8.2.8 Come up with creative solutions to problems.</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Project Application Development - 3713IT221A

Assessment objectives/criteria	<p>After successfully finishing this project, the student can:</p> <ul style="list-style-type: none"> <li>■ Use a version control system to coordinate the work within the team</li> <li>■ Choose a software development method suitable to the situation at hand</li> <li>■ Analyse the math involved in real-life problems</li> <li>■ Transform the math to a software design</li> <li>■ Implement the design made in the previous step in software</li> <li>■ Create and maintain technical documentation for the application</li> </ul> <p>Besides these specific criteria, students will be assessed on general project skills (Advise, Professionalize and Research)</p>
Details of assessments	<p>Students are assessed on the quality of the product, the quality of the report, the quality of their project work and the final presentation of the project. All aspects should be a Pass mark. Furthermore, they are assessed on their individual contribution to the final results; this also has to be a pass.</p> <p>If students fail either the product or the presentation, they can redo this a week later. Failing the process or individual contribution cannot be repaired during a resit; the whole project will have to be redone entirely. This may not be possible during the same year.</p>
Strategies and	Activities consist of general class feedback, group sessions and feedback and working as a group on the

teaching activities	models, application and report.	
Compulsory attendance (See also Article 115 TER)	Yes	<p>During a project, visible execution and performance of vital skills such as mutual cooperation, communication with and to stakeholders and giving and receiving feedback and acting accordingly upon as such, form part of the examining and grading. For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking. These criteria have been set at 80%.</p> <p>Setting the criteria at 80% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences.</p> <p>These criteria have been explicitly stipulated for this project in the project description, leaving no room for ambiguous interpretations at the start of the project</p>
Permitted aids	The student may use any means, provided that they do the project themselves, and the student must be clear in their source.	

## Software Engineering - 3719IT211Z

Content of unit of study	<p>Very small information systems can be developed on the fly; usually the client is clear, might even be the same as the developer, and the requirements can be easily understood. It already becomes more complicated if the algorithms involved are non-trivial, and when system grows larger and needs to be maintainable as well, the 'code as you go' approach ceases to produce usable results.</p> <p>Another problem you run into is the need to adapt the information system to changing needs, or expand it to accommodate new requirements. The difference between a programmer and a software engineer is the ability to take all these – often conflicting – requirements and follow a path to the analysis, design and implementation of an information system which stays useful and used over time.</p> <p>This course addresses the systematic (agile) approach to the design and development of (large) IT systems. It will cover requirements analysis and design techniques such as software architecture, design (anti)patterns and use case modelling. Besides more traditional development methodologies some agile principles such as software quality and refactoring will be discussed.</p>	
Learning outcomes	<p>1.2.3 - Translate an information question into a programmable problem within a given architecture.</p> <p>2.2.3 - Design an app, application or information system, selecting a suitable modelling technique.</p> <p>4.1.1 - Set up and use a control system to support software development in a team setting.</p> <p>4.1.3 - Use management protocols and systems for data management.</p> <p>5.1.1 - List and select project methods and software development methods.</p> <p>7.2.5 - Analyse requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment</p>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details		

### Assessment: Software Engineering - 3719IT211A

Assessment objectives/criteria	<p>After successfully completing this module, the student is able to:</p> <ul style="list-style-type: none"> <li>■ Translate the information needs of a client to functional specifications (1.2.3)</li> <li>■ Document the functional specifications using UML Use Cases (1.2.3)</li> <li>■ Avoid using anti-patterns when designing the architecture of a new information system (2.2.3, 4.1.3)</li> <li>■ Document an existing software architecture using UML (2.2.3)</li> <li>■ Choose a software development method and modelling technique suitable for the problem at hand (4.1.3, 5.1.1)</li> <li>■ Work systematically from vaguely defined information needs to an application able to fulfil those</li> </ul>
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	(7.2.5)	
Details of assessments	On the exam a case study will be used for similar purpose as during classes. If this case study requires extensive reading it will be made available for reading before the exam.	
Strategies and teaching activities	<p>During class, problems are explained and possible solutions are discussed. This is intermingled with solutions from theory. A large and free-format practical case is used throughout the course to apply all theory on; this case study forms a thread throughout the course.</p> <p>In the Head First course book there are several exercises. These should be done by students between classes. The other books do not have exercises in them; instead, exercises and assignments are given in the PowerPoint sheets and/ or as separate documents on Moodle.</p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## Operations Research - 3713IT334Z

Content of unit of study	There are a lot of algorithms for optimizing problems. In Operations Research we will have a look at some of the Mathematical programming: Graphical/Simplex method, Inventory Models, Branch & Bound, Integer programming, some of General Models.	
Learning outcomes	<ol style="list-style-type: none"> <li>1. 1.2.1 Analyse a problem using mathematical models.</li> <li>2. 2.2.1. Tailor a complex given mathematical model to a problem.</li> <li>3. 6.2.1. Create a recommendation based on substantiated arguments.</li> </ol>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

### Assessment: Operations Research - 3713IT334A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ ( 1.3.1 ) Investigate a practical problem by a model</li> <li>■ ( 2.3.1 ) Solve a practical problem by a model with a Mathematical programming approach</li> <li>■ ( 1.3.1 ) Research the influences of the constraints for the effect of the solution</li> <li>■ ( 6.2.1 ) Recommend a decision based on the calculated solution in the Model</li> </ul>	
Details of assessments	Written exam	
Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

### Term 3

## Numerical Analysis - 3719IT231Z

Content of unit of study	This Class helps the student to understand what numerical algorithms will do. The topics are Errors, Approximations, Interpolations, Numerical Integration and Linear Equations. The mathematical theory behind these topics will be studied, so that good Algorithms can be found.
Learning outcomes	<ol style="list-style-type: none"> <li>1. 1.2.1 Analyse a problem using mathematical models.</li> <li>2. 1.3.1 Analyse the accuracy and the value of a mathematical model.</li> <li>3. 2.2.1. Tailor a complex given mathematical model to a problem.</li> </ol>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Numerical Analysis - 3719IT231A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>▪ ( 1.2.1 ) Analyze problems for Errors, Approximations, Interpolations, Numerical Integration and Linear Equations</li> <li>▪ ( 3.3.1 ) Solve problems for Errors, Approximations, Interpolations, Numerical Integration and Linear Equations</li> <li>▪ ( 2.2.1 ) Make an Algorithm of the solution</li> <li>▪ ( 1.3.1 ) Evaluate the result in comparison with the ( unknown ) solution</li> </ul>	
Details of assessments	Written Exam	
Strategies and teaching activities	Lectures, Labs	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## English 4 - 3719IT232Z

Content of unit of study	<p>Academic writing requires students to look at ideas and research from a different perspective. Students have to learn to analyze theories from a number of different viewpoints and then write based on what they understand. To think critically and objectively is a useful skill for people to learn early on in life, as the ability to look at things objectively is something that will benefit them in real life.</p> <p>Academic writing has a strong focus on technique and how it should be used to best convey ideas. If students learn about style and how to write essays early on in their academic careers, they will find it much easier to write papers later in subsequent phases of university.</p> <p>Presenting the research: students will present their written work in a brief, individual presentation. The course aim is to demonstrate writing skills at level B2/ C1 of the CEFR.</p>
Learning outcomes	<p>8.2.4 Demonstrate an appropriate professional attitude.</p> <p>8.2.5 Communicate effectively with multiple stakeholders in an intercultural environment</p>
Requirements for participation in units	None

of study (See also Article 29 TER) Specific details	Prerequisites: the level of written English should at least be at B2 of the CEFR Having completed ENG1 – 3 is preferred. Students are expected to have full knowledge of all aspects shared in these courses.
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## Assessment: English 4 - 3719IT232A

Assessment objectives/criteria	<p><b>ACADEMIC WRITING</b></p> <p><b>Further details about assessment:</b></p> <p>The final exam consists of a term paper that demonstrates academic writing skills at level B2/ C1. (Cambridge style writing assessment). Your paper should include ethical/social and legal aspects. In this course “Academic Writing and Critical Reading,” You will learn to work with the fundamental concepts of academic writing that all students and scholars use, including planning and revision of your work. Academic writing is of course based on critical reading:</p> <ul style="list-style-type: none"> <li>■ reading closely to analyse texts and question sources;</li> <li>■ reasoning with evidence;</li> <li>■ organizing persuasive and well-structured arguments;</li> <li>■ and communicating your ideas in clear and effective prose.</li> </ul> <p>Key concepts of academic argument—such as:</p> <ul style="list-style-type: none"> <li>■ Thesis</li> <li>■ Motive</li> <li>■ Evidence</li> <li>■ and structure</li> </ul> <p>will be introduced and reviewed; you will also learn strategies for reading and analysing complex texts.</p> <p><b>Assessment-The Cambridge grading rubric consists of the following categories:</b></p> <ul style="list-style-type: none"> <li>■ Content</li> <li>■ Language</li> <li>■ Organisation</li> <li>■ Communicative Achievement</li> </ul> <ol style="list-style-type: none"> <li>1. Selecting the correct format and style for specific tasks.</li> <li>2. Presenting the information using a coherent structure.</li> <li>3. Controlling a range of grammatical structures.</li> <li>4. Using a range of cohesive devices to connect ideas.</li> <li>5. Showing awareness of the function of the text.</li> <li>6. Presenting different aspects of a topic to inform the reader.</li> <li>7. Demonstrating use of a wide range of vocabulary.</li> <li>8. Fulfilling the purpose of the task.</li> </ol> <p><b>PRESENTATION</b></p> <p>Students present their research in a brief, individual presentation.</p> <p><b>Assessment criteria</b></p> <p>The presentation is assessed on the following criteria:</p> <ul style="list-style-type: none"> <li>■ Used aids in media, such as PowerPoint, Prezi, Rocket Slide etc., attractiveness of the presentation</li> <li>■ Topic, complexness or execution of the assignment</li> <li>■ Pronunciation</li> <li>■ Structured presentation: introduction, body, conclusion, sign-posting, presentation techniques, attitude in front of the class, meeting conventions for presentations</li> <li>■ Interaction with class during questions</li> </ul> <p>Students attending the presentation are required to ask questions, have a participative attitude and a keen sense for facts versus opinions. Audience participation is mandatory and roles will be divided for giving feedback.</p>	
Details of assessments	<p>Written without a formal test sitting.</p> <p>In class debate (P/F)</p>	
Strategies and teaching activities	<p>The instructional format and educational activities consist of 7 x 4 classes in the form of workshops and lectures in which an proactive, participating attitude is expected; an in-term debate which forms part of the final grade, followed by an individual exam (written assignment)</p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	<p>Individual paper – written outside of class aids and sources permitted. Presentation: to be decided by</p>	

## ME learning challenge 2 - 3719IT233Z

Content of unit of study	<p>The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education in this field is never complete. To keep up with the latest developments, a mathematical engineer must be able to direct their own learning process throughout their career.</p> <p>During the ME Learning Challenge students have the opportunity to shape their own learning process by delving into a topic of their choice. Students are encouraged to pursue their own interests and ambitions.</p> <p>The Learning Challenge is a one-week intensive course for students from years 1 and 2. Before the course starts, students indicate which topics they would like to work on. Students are free to suggest any topics that are related to the ME competencies, but that are not part of the core curriculum. Based on their preferences the teachers assign students to a learning team and a topic. Learning teams can consist of students from different levels. During the course week, students from the team work together on learning the topic. Students choose their own educational resources, make a work plan, and guide their own learning. Teachers are available for assistance in the role of learning coaches. At the end of the week, students present the outcomes of their learning in a suitable way to the coaches and peers.</p>
Learning outcomes	<ul style="list-style-type: none"> <li>■ Create, track and update a project plan. (5.1.2)</li> <li>■ Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies. (5.1.3)</li> <li>■ Consult effectively and efficiently with those involved. (5.1.4)</li> <li>■ Allocate and delegate tasks within a project. (5.1.5)</li> <li>■ Collaborate effectively in an intercultural (project) team in a setting with multiple stakeholders. (8.2.1)</li> <li>■ Direct and substantiate the development of personal professional competencies. (8.2.2)</li> <li>■ Apply knowledge, insights and skills and transfer these to others. (8.2.3)</li> <li>■ Demonstrate an appropriate professional attitude. (8.2.4)</li> <li>■ Communicate effectively with multiple stakeholders in an intercultural environment. (8.2.5)</li> <li>■ Contribute to a safe and respectful work environment. (8.2.6)</li> <li>■ Operate in critical situations in an independent and stress-free manner. (8.2.7)</li> <li>■ Come up with creative solutions to problems. (8.2.8)</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: ME learning challenge 2 - 3719IT233A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Define learning objectives for a learning task;</li> <li>■ Select suitable educational resources;</li> <li>■ Create a work plan for a learning task;</li> <li>■ Effectively develop professional competences at their study level by working according to a work plan;</li> <li>■ Effectively guide the learning process of a learning team;</li> <li>■ Communicate effectively with coaches and members of a learning team;</li> <li>■ Present the outcomes of a learning process;</li> <li>■ Reflect critically on the applied learning methods and learning process;</li> <li>■ Effectively intervene when problems arise.</li> </ul>
Details of assessments	
Strategies and teaching activities	Students study in a learning team coached by lecturers.
Compulsory attendance (See	Yes

also Article 115 TER)	
Permitted aids	All

## Graph Theory - 3719IT234Z

Content of unit of study	<p>A graph is a mathematical model that consists of entities and relations between entities. Graphs can be used to model a variety of real-world networks, such as social networks, computer networks, road networks, and the World Wide Web. The field of Graph Theory provides a tool box for analyzing properties of graphs and answering questions about the networks. For example, one may ask: who is the most central person in a social network? What is the shortest route from location A to location B? How vulnerable is a computer network to node failure?</p> <p>In the Graph Theory course, students learn to translate real-world situations to mathematical graphs. Important graph theoretical concepts and algorithms are studied. In addition, the course covers several mathematical proof techniques, necessary to proof statements about graphs.</p>
Learning outcomes	<ul style="list-style-type: none"> <li>Analyze a problem using mathematical models. (1.2.1)</li> <li>Tailor a complex given mathematical model to a problem. (2.2.1)</li> <li>Design an algorithm for a simple problem. (2.2.2)</li> <li>Design a data structure suited to a problem. (2.2.4)</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Graph Theory - 3719IT234A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>Recognize various mathematical proof techniques.</li> <li>Explain the steps of a given mathematical proof.</li> <li>Translate a real-world problem to a graph problem.</li> <li>Determine whether graph theoretical concepts apply to a given graph.</li> <li>Apply graph algorithms to a given graph.</li> <li>Make use of network analysis techniques to analyze a given graph.</li> <li>Interpret the results of network analysis techniques in the context of the original problem.</li> </ul>
Details of assessments	
Strategies and teaching activities	Instructions and exercises
Compulsory attendance (See also Article 115 TER)	No
Permitted aids	None

## Object Oriented Programming 3 - 3719IT235Z



Content of unit of study	<p>Object Oriented Programming 1 started with the concepts of object orientation and its design and implementation using Java, while Object Oriented Programming 2 continued with Generics, Collections and building a complete Graphical User Interface. After finishing those courses students are able to create complete stand-alone Java applications performing simple to intermediate complex algorithms.</p> <p>The type of applications a professional in the field often will be required to design and implement has a few properties making this task more complicated than this.</p> <p>This course forms the capstone of the Object Oriented Programming stream. Several techniques are covered to tackle the above-mentioned issues. After successfully finishing this module, the student will be able to create maintainable Java applications for complex situations or expand upon an existing one.</p>
Learning outcomes	<p>2.2.3 - Design an app, application or information system, selecting a suitable modelling technique.</p> <p>2.3.3 - Design an app, application or information system suited to the existing or desired environment.</p> <p>3.2.1 - Implement the application of a designed algorithm or mathematical model of limited scope.</p> <p>3.3.2 - Build, test and deliver an app, application or information system that fits within the existing or desired environment.</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	

### Assessment: Object Oriented Programming 3 - 3719IT235A

Assessment objectives/criteria	<p>After successfully completing this module, the student is able to:</p> <ul style="list-style-type: none"> <li>▪ Design an application in a way fitting with the purpose and environment of it (2.2.3)</li> <li>▪ Translate an information requirement to a technical design in an existing architecture (2.3.3)</li> <li>▪ Use multithreading to implement a known but complex algorithm with a limited scope (3.2.1)</li> <li>▪ Use streams to implement algorithms exhibiting properties from the mathematical concept of collections (3.2.1)</li> <li>▪ Use external libraries to add functionality to an application (3.2.2)</li> <li>▪ Implement new functionality in a given architecture (3.3.2)</li> </ul>	
Details of assessments	<p>During the term three assignments are given, with a deadline given with each assignment. These assignments cover part of the materials and together count for 50% of the final grade.</p> <p>At the end of the term a final assignment is given. This assignment mainly covers the more advanced topics as well as those from the last two classes. This assignment counts for 50% of the final grade.</p>	
Strategies and teaching activities	<p>There are two classes a week. During the first class most theory will be covered, interspersed by exercises. These exercises have to be finished between the two classes. The second class focuses on practicing the topics covered and deepens and connects them.</p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All (online) literature permitted, as long as this does not constitute academic misconduct	

## Research 2 - 3713IT235Z

Content of unit of study	<p>In the research courses the student develops the soft skills needed for successfully conducting applied research projects during their studies and in their professional life. The focus of this course is quantitative research. Quantitative research methodologies are discussed and put into practice in a small-scale study.</p>
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Learning outcomes	<ul style="list-style-type: none"> <li>7.3.3. Determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives.</li> <li>7.3.4 Reflect critically on the planned approach and actual implementation of a study.</li> <li>7.3.5 Making a theoretically substantiated choice for research methods to answer the research questions.</li> <li>7.3.6 Reflect critically on the choices made in a study and describe the consequences of those choices.</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Research 2 - 3713IT235A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>Select an appropriate quantitative research methodology for a research problem.</li> <li>Independently conduct a small quantitative study.</li> <li>Determine the applicability of inferential statistics for a real-world problem.</li> <li>Select suitable statistical techniques to analyze quantitative research results.</li> <li>Perform inferential statistical analysis on quantitative research results.</li> <li>Reflect critically on research outcomes.</li> <li>Write a research report about a quantitative study.</li> </ul>
Details of assessments	The grade will be based on the quality of the research paper and the presentation.
Strategies and teaching activities	Instructions and working on assignment.
Compulsory attendance (See also Article 115 TER)	No
Permitted aids	All

### Term 4

## Project Web Science - 3719IT241Z

Content of unit of study	<p>The World Wide Web is without doubt the single most important source of information that has ever been available. At the same time it is also the least controlled and understood source. How is all this information structured? Who are its users? How is it used? Web Science aims to answer these questions by studying the techniques, users, and structure of the web.</p> <p>Web science is practiced out of pure curiosity as well as for gaining strategic advantage. For example, companies monitor their online presence by analyzing Twitter conversations in which they are mentioned. Search engines analyze link structure to identify authoritative web sites. News agencies crawl blogs and social media to get real-time information about unexpected events.</p> <p>In this project students will research part of the web by application of various web science methods. The theoretical foundation of these methods were laid in the courses on Graph Theory and Algorithms and Data Structures. For the practical application software development skills are needed as covered in the courses Software Development, Python, and Object Oriented Programming. Finally, this course requires the skills developed in the Research courses.</p>
Learning outcomes	

	<ul style="list-style-type: none"> <li>Analyze a problem using mathematical models. (1.2.1)</li> <li>Tailor a complex given mathematical model to a problem. (2.2.1)</li> <li>Design an algorithm for a simple problem. (2.2.2)</li> <li>Design a data structure suited to a problem. (2.2.4)</li> <li>Implement the application of a designed algorithm or mathematical model of limited scope. (3.2.1)</li> <li>Apply data-driven methods for monitoring processes or systems. (4.1.4)</li> <li>Create, track and update a project plan. (5.1.2)</li> <li>Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies. (5.1.3)</li> <li>Consult effectively and efficiently with those involved. (5.1.4)</li> <li>Allocate and delegate tasks within a project. (5.1.5)</li> <li>Create an advisory report according to the guidelines. (6.2.3)</li> <li>Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background. (7.2.1)</li> <li>Provide multiple solutions to encountered problems and make an informed choice for a solution. (7.2.2)</li> <li>Select a method for determining the effectiveness of a chosen solution. (7.2.3)</li> <li>Write and adapt a research proposal and/or research plan taking the interests of multiple stakeholders into account. (7.2.4)</li> <li>Analyze requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment. (7.2.5)</li> <li>Formulate a relevant research question and subquestions for a research study. (7.2.6)</li> <li>Collaborate effectively in an intercultural (project) team in a setting with multiple stakeholders. (8.2.1)</li> <li>Direct and substantiate the development of personal professional competencies. (8.2.2)</li> <li>Apply knowledge, insights and skills and transfer these to others. (8.2.3)</li> <li>Demonstrate an appropriate professional attitude. (8.2.4)</li> <li>Communicate effectively with multiple stakeholders in an intercultural environment. (8.2.5)</li> <li>Contribute to a safe and respectful work environment. (8.2.6)</li> <li>Operate in critical situations in an independent and stress-free manner. (8.2.7)</li> <li>Come up with creative solutions to problems. (8.2.8)</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Project Web Science - 3719IT241A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>translate a real-world question into a web science problem;</li> <li>model (part of) a web site as a graph;</li> <li>select appropriate data structures for a web science problem;</li> <li>select appropriate graph algorithms for solving a web science problem;</li> <li>create an efficient implementation of graph theoretical concepts;</li> <li>analyze graphs that are too large to be visualized in full;</li> <li>evaluate the consequences of graph theoretical properties for real world graphs;</li> <li>effectively manage a research project of limited size;</li> <li>report on a research project in a research paper and a presentation;</li> <li>select relevant, trustworthy, and recent sources to substantiate choices;</li> <li>effectively collaborate in a research team.</li> </ul> </li> </ul>
Details of assessments	The grade will be based on the quality of the research and the report, and the individual performance of the student.
Strategies and teaching activities	Instructions and group work.
Compulsory attendance (See also Article 115 TER)	Yes
Permitted aids	All

# Cryptography - 3711IT423Z

Content of unit of study	<p>Cryptography can be considered as part of Information Security. Cryptography can be found everywhere: Web browsers, on-line banking, wireless lan's, e-mail programs, cell phones, bank cards, RFID tags etc. Individual users, businesses and organizations worldwide can only communicate in a secure way over open (= unsafe) networks if cryptographic tools are used. Encryption, digital signatures, password-based authentication, are some of the basic cryptographic techniques to achieve secure communication and to prevent hackers and attackers to break into computer systems, steal information, change data etc.</p> <p>Cryptography plays an important role in the defense against such attacks, and that's why this course deals almost exclusively with studying cryptography and the underlying mathematics.</p>
Learning outcomes	<ol style="list-style-type: none"> <li>1. 1.3.1 Analyse the accuracy and the value of a mathematical model.</li> <li>2. 2.3.1 Select a mathematical model and tailor it to a complex problem.</li> <li>3. 2.2.1. Tailor a complex given mathematical model to a problem.</li> </ol>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

## Assessment: Cryptography - 3711IT423A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>▪ ( 1.1.1 ) understanding Cryptography by historical evolution</li> <li>▪ ( 2.3.1 ) applying symmetric ciphers: block ciphers and stream ciphers ( DES and AES )</li> <li>▪ ( 2.3.1 ) applying asymmetric ciphers: RSA, DHKE, Elgamal Encryption</li> <li>▪ ( 1.3.1 ) analyzing a problem for the right cipher</li> <li>▪ ( 1.3.1 ) evaluating the security of the chosen cipher</li> </ul>
Details of assessments	Written Exam
Strategies and teaching activities	Lectures
Compulsory attendance (See also Article 115 TER)	No
Permitted aids	None

# Professional skills 5 - 3719IT243Z

Content of unit of study	<p>In Professional Skills you learn how to manage your own study career. One of the lecturers of Mathematical Engineering will be assigned to be your study coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>The course in this semester will focus on competency development and related to your competency development, the obtaining of an internship. What are the steps to take, how to make a smart planning and</p>
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	how to prepare for a job interview. Attention will be paid to your personal branding with LinkedIn and job interviews. And we will continue reflecting on the moral/ethical/legal aspects of big data.
Learning outcomes	Directs and substantiates the development of personal professional competencies, using input such as feedback and self-reflection. (8.2.2) Demonstrate an appropriate professional attitude. (8.2.4)
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Professional skills 5 - 3719IT243A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>▪ The student:</li> <li>▪ applies the SMART methodology correctly. (8.2.2)</li> <li>▪ applies the STARR methodology correctly. (8.2.2)</li> <li>▪ reflects on his/her strong point and demonstrate this in an effective LinkedIn Profile. (8.2.2)</li> <li>▪ reflects on moral/ethical/legal aspects of big data ethical and demonstrates this in a written assignment and in group discussions. (8.2.4)</li> </ul>	
Details of assessments		
Strategies and teaching activities	Instructions, presentations and group discussions as well as individual meetings	
Compulsory attendance (See also Article 115 TER)	Yes	Individual sessions and presentations have compulsory attendance
Permitted aids	n.a.	

## Algorithms & Datastructures - 3719IT244Z

Content of unit of study	This course covers data structures and algorithms as used in computer programming. A data structure is an arrangement of data in the computer's memory or on disk. An algorithm describes the procedure a program uses to manipulate the data in this structure in a specific way. Almost all programs use data structures and algorithms. For simple programs with small amounts of data, a straightforward approach might be all you need. However, for programs of a more complex nature or when dealing with large amounts of data, more sophisticated techniques are necessary. In this course various algorithms and data structures are explained, including linked lists, stacks, queues, sorting algorithms, binary search trees, self-balancing trees, hashes, string processing algorithms, regular expressions, and compression algorithms. The course focuses on the working of the algorithms, analysis of the complexity of algorithms, the application to various types of problems, and the implementation in Java.
Learning outcomes	<ul style="list-style-type: none"> <li>▪ Determine the scalability of algorithms. (1.2.2)</li> <li>▪ Perform a complexity analysis of an algorithm using mathematical demonstration. (1.3.2)</li> <li>▪ Translate an information question into a programmable problem. (1.3.3)</li> <li>▪ Design an algorithm for a simple problem. (2.2.2)</li> <li>▪ Design a data structure suited to a problem. (2.2.4)</li> <li>▪ Implement the application of a designed algorithm or mathematical model of limited scope.(3.2.1)</li> <li>▪ Build, test and deliver a data structure. (3.2.3)</li> </ul>

Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Algorithms & Datastructures - 3719IT244A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Explain the role of algorithms and data structures in applications.</li> <li>■ For the following data structures: linked lists, bags, queues, stacks, binary search trees, self-balancing trees, hashes <ul style="list-style-type: none"> <li>■ implement various representations of the data structures in memory;</li> <li>■ manually execute the algorithms for manipulating these data structures;</li> <li>■ compare the strong and weak points of the data structures.</li> </ul> </li> <li>■ For sorting algorithms, string processing algorithms, and compression algorithms <ul style="list-style-type: none"> <li>■ manually execute the algorithms;</li> <li>■ compare the strong and weak points of the algorithms;</li> <li>■ compute the worst-case computational complexity of the algorithms;</li> </ul> </li> <li>■ Construct regular expressions for string finding problems.</li> <li>■ Set up experiments to test the average-case computational complexity of algorithms.</li> <li>■ Implement algorithms and data structures.</li> <li>■ Construct algorithms for real-world problems using appropriate existing algorithms and data structures.</li> </ul>	
Details of assessments		
Strategies and teaching activities	Instructions and lab exercises	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## Management & Organization - 3719IT245Z

Content of unit of study	In this module we will focus on all kinds of business and organisational aspects. You will learn about the basis structures of organisations end organisational cultures. Als we will focus on business strategies and management of personel or Human Resources Management.
Learning outcomes	management, professionalization
Requirements for participation in units of study (See also Article 29 TER)	n/a
Specific details	n/a

### Assessment: Management & Organization - 3719IT245A

Assessment objectives/criteria	<p>after this module the student will be able to:</p> <ol style="list-style-type: none"> <li>1. recognize and analyze much used theoretical models of organisational management;</li> <li>2. recognize and discuss the steps of a strategy process for organizations.</li> <li>3. recognize and discuss how efficient and affective the structure of the organization is for obtaining the specified goals;</li> <li>4. recognize and discuss the culture of an organization based on well know theoretical models;</li> </ol>
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	5. recognize and discuss theoretical models on leadership;	
Details of assessments		
Strategies and teaching activities	instructions and excersizes	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	none	

## Year 3

### Basic curriculum

#### Semester 1

## Internship - 3711IT321Z

Content of unit of study	<p>Mathematical Engineering applies mathematical techniques in an IT context. The focus is on solving complex IT problems in which elementary solutions do not suffice for reasons of specific purposes or high requirements in reliability or volume of data. These types of problems may be found in numerous sectors, including but not limited to IT sectors such as software development, networking, business intelligence and data analysis.</p> <p>The internship period is intended on the one hand to let students experience the above practice, and on the other hand, to enable them to test the knowledge and skills gained during their studies in a real-life business environment. This gives students a perspective on their professional possibilities.</p> <p>The internship period is an important part of programme. Not just for the reasons above, but also because a student's experiences during the internship contribute to a well-considered choice in their further studies and future career. Furthermore, these experiences will have added value for the student's studies in years 3 and 4.</p>
Learning outcomes	<p>5.1.1 List and select project methods and software development methods.</p> <p>5.1.2 Create, track and update a project plan.</p> <p>5.1.4 Consult effectively and efficiently with those involved.</p> <p>6.2.1 Create a recommendation based on substantiated arguments.</p> <p>6.2.2 Communicate effectively, both orally and in writing, with people of various ranks.</p> <p>6.2.3 Create an advisory report according to the guidelines.</p> <p>7.2.1 Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background.</p> <p>7.2.2 Provide multiple solutions to encountered problems and make an informed choice for a solution.</p> <p>7.2.3 Select a method for determining the effectiveness of a chosen solution.</p> <p>7.2.4 Write and adapt a research proposal and/or research plan taking the interests of multiple stakeholders into account.</p> <p>7.2.5 Analyse requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment.</p> <p>7.2.6 Formulate a relevant research question and subquestions for a research study.</p>

	8.2.1 Collaborate effectively in an intercultural (project) team in a setting with multiple stakeholders. 8.2.2 Direct and substantiate the development of personal professional competencies. 8.2.3 Apply knowledge, insights and skills and transfer these to others. 8.2.4 Demonstrate an appropriate professional attitude. 8.2.5 Communicate effectively with multiple stakeholders in an intercultural environment. 8.2.6 Contribute to a safe and respectful work environment. 8.2.7 Operate in critical situations in an independent and stress-free manner. 8.2.8 Come up with creative solutions to problems.
Requirements for participation in units of study (See also Article 29 TER)	A student is allowed to start the Internship only when: <ul style="list-style-type: none"> <li>he/she has completed the foundation programme (year 1);</li> <li>he/she has achieved 100EC of the first and second year</li> <li>the internship proposal has been approved by the internship coordinator (Note: the internship <u>always</u> only starts <u>after</u> the approval, never before.)</li> </ul>
Specific details	None.

### Assessment: Internship - 3711IT321A

Assessment objectives/criteria	The student can: <ul style="list-style-type: none"> <li>independently acquire new knowledge and skills;</li> <li>apply knowledge and skills learned at school in a real-world situation;</li> <li>function in a professional environment;</li> <li>set up and conduct a small applied research project;</li> <li>communicate orally and in writing about a research project.</li> </ul>	
Details of assessments	The grade will be based on the project plan, the internship report, the work done and the evaluation of the organization the student did the internship in.	
Strategies and teaching activities	The internship project is conducted within the external organization. The student is supervised by a school supervisor and a company supervisor and has regular meetings with both.	
Compulsory attendance (See also Article 115 TER)	Yes	The whole thesis project is done on-premise at the organization.
Permitted aids	N/A	

## Year 4

### Basic curriculum

#### Term 1

## Data Mining & Analysis - 3711IT411Z

Content of unit of study	Companies use data about their customers to predict how changes in prices will affect what customers buy. Meteorologists use data collected by weather stations and satellites to forecast tomorrow's weather. Police officers need to determine whether signatures are genuine. Network Administrators must recognize malicious actions between all the traffic on a network. In all these examples the key is Data Analysis and Mining.
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	<p>Data mining is defined as the process of discovering patterns in data, lots of data. This course treats a wide variety of data analysis and data mining techniques, such as regression, dimension reduction methods, decision trees, clustering methods, Bayesian models, and instance-based learning. We treat the practical application of the techniques as well as the theories behind them. Especially the interpretation and evaluation of discovered structural patterns require theoretical analysis and qualification.</p> <p>To be applicable in any realistic setting data analysis and mining must be done automatically. In the course students get acquainted with three software packages: SPSS for statistical data analysis and Weka and Rapidminer for data mining.</p> <p>To understand data mining algorithms and evaluation techniques, it is necessary to master the concepts treated in the probability theory and statistics courses. Techniques addressed in this course will be applied in Project Big Data.</p>
Learning outcomes	<ul style="list-style-type: none"> <li>Analyse the accuracy and the value of a mathematical model. (1.3.1)</li> <li>Identify the business objectives of a data science project. (1.3.5)</li> <li>Select a mathematical model and tailor it to a complex problem. (2.3.1)</li> <li>Design an algorithm for a complex problem. (2.3.2)</li> <li>Design a Big Data environment. (2.3.4)</li> <li>Select suitable data mining methods for a complex data science problem. (2.3.5)</li> <li>Build, evaluate, and deliver a predictive model based on one or more complex data sets. (3.3.4)</li> </ul>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Data Mining & Analysis - 3711IT411A

Assessment objectives/criteria	<p>After successfully completing this module, the student is able to:</p> <ul style="list-style-type: none"> <li>explain the goals of data mining;</li> <li>explain the different data mining tasks;</li> <li>explain the main five steps of the data mining process;</li> <li>convert a real-world problem into a data analysis or mining task;</li> <li>choose an appropriate data mining method for a real-world problem;</li> <li>independently explore a data set;</li> <li>by means of statistical or data mining software preprocess a real-world data set to prepare it for data analysis and mining;</li> <li>explain the working, advantages, and disadvantages of a number of prediction, classification, and clustering algorithms;</li> <li>manually apply a number of prediction, classification, and clustering algorithms to a small example data set;</li> <li>apply a number of prediction, classification, and clustering algorithms to a realistic data set by means of data mining software;</li> <li>set-up and conduct a data mining experiment;</li> <li>interpret the results of a data mining experiment;</li> <li>identify common difficulties in data mining projects.</li> </ul>	
Details of assessments	The exam consists of open questions.	
Strategies and teaching activities	Instructions and lab sessions.	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Calculator	



## Advanced Data Disclosure - 3718IT411Z

Content of unit of study	
Learning outcomes	
Requirements for participation in units of study (See also Article 29 TER)	
Specific details	

### Assessment: Advanced Data Disclosure - 3712IT411A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ choose a suitable data storage and retrieval method for a real-world problem;</li> <li>■ explain the various ways to distribute databases;</li> <li>■ write queries for NoSQL databases;</li> <li>■ explain the working of various components of a natural language processing system;</li> <li>■ select suitable text preprocessing and mining algorithms for a textual data set;</li> <li>■ apply algorithms for text preprocessing and mining to small scale problems;</li> <li>■ apply algorithms for text retrieval to small-scale problems.</li> </ul>	
Details of assessments	The assignment must be sufficient to pass the course. The grade is determined by the exam consisting of open question.	
Strategies and teaching activities	Instructions and lab sessions	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Calculator	

## ME learning challenge 4 - 3718IT412Z

Content of unit of study	<p>The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education in this field is never complete. To keep up with the latest developments, a mathematical engineer must be able to direct their own learning process throughout their career.</p> <p>During the ME Learning Challenge students have the opportunity to shape their own learning process by delving into a topic of their choice. Students are encouraged to pursue their own interests and ambitions. The Learning Challenge is a one-week intensive course for students from years 1 and 2. Before the course starts, students indicate which topics they would like to work on. Students are free to suggest any topics that are related to the ME competencies, but that are not part of the core curriculum. Based on their preferences the teachers assign students to a learning team and a topic. Learning teams can consist of students from different levels. During the course week, students from the team work together on learning the topic. Students choose their own educational resources, make a work plan, and guide their own learning. Teachers are available for assistance in the role of learning coaches. At the end of the week, students present the outcomes of their learning in a suitable way to the coaches and peers.</p>	
Learning outcomes	<ul style="list-style-type: none"> <li>■ Create, track and update a project plan. (5.1.2)</li> <li>■ Consult effectively and efficiently with those involved. (5.1.4)</li> </ul>	

	<ul style="list-style-type: none"> <li>Collaborate effectively in an intercultural (project) team. (8.1.1)</li> <li>Reflect on own behaviour and give and receive feedback in an appropriate way. (8.1.2)</li> <li>Demonstrate an appropriate (study) attitude. (8.1.4)</li> <li>Communicate effectively, both orally and in writing. (8.1.5)</li> <li>Contribute to a respectful study environment. (8.1.6)</li> </ul> <p>Work according to agreements and planning. (8.1.7)</p>
Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: ME learning challenge 4 - 3718IT412A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>Define learning objectives for a learning task.</li> <li>Select suitable educational resources.</li> <li>Create a work plan for a learning task.</li> <li>Effectively develop professional competences at their study level by working according to a work plan.</li> <li>Collaborate effectively in a learning team.</li> <li>Communicate effectively with coaches and members of a learning team.</li> <li>Present the outcomes of a learning process.</li> <li>Reflect critically on the applied learning methods and learning process.</li> </ul>	
Details of assessments		
Strategies and teaching activities	Students study in a learning team coached by lecturers.	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All	

## Research 4 - 3711IT422Z

Content of unit of study	In the research courses the student develops the soft skills needed for successfully conducting applied research projects during their studies and in their professional life. The focus of this course is literature study. Students learn how to find and apply literature in a structured way during the various phases of the research cycle.	
Learning outcomes	<ul style="list-style-type: none"> <li>Create an advisory report according to the guidelines. (6.2.3)</li> <li>Select and apply relevant, trustworthy, and recent sources to get a better understanding of the research question and subquestions. Sources need to be varied and of high enough level. (7.3.1)</li> <li>Reflect critically on the planned approach and actual implementation of a study. (7.3.4)</li> <li>Making a theoretically substantiated choice for research methods to answer the research questions. (7.3.5)</li> <li>Reflect critically on the choices made in a study and describe the consequences of those choices. (7.3.6)</li> </ul>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

## Assessment: Research 4 - 3711IT422A

Assessment objectives/criteria	<ul style="list-style-type: none"><li>Find literature relevant to a research topic.</li><li>Assess the quality of literature.</li><li>Recognize various types of literature review.</li><li>Set-up and conduct a literature review.</li><li>Reflect critically on a literature review.</li><li>Write a paper about a literature review.</li></ul>	
Details of assessments	The grade will be based on the quality of the research paper and presentation.	
Strategies and teaching activities	Instructions and working on assignment.	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All	

## Study Career Coaching 6 (SCC) - 3712IT425Z

Content of unit of study	<p>Studying is far more than just gathering knowledge and getting a degree. En route towards the degree, acquiring certain skills and gaining a professional attitude are entwined with your development into a professional.</p> <p>Within the University of Applied Sciences we mainly focus on acquiring 'competences'. In Holland uses the following definition of 'competences': 'the mental tools that allow you to execute various professional tasks. Apart from knowledge, it also means forming and developing skills, insight and attitude. Combined, this will provide the graduate with the ability to act adequately in critical professional situations, and to reflect upon this'</p> <p>In study career coaching (SCC) you learn how to manage your own study career. You learn to recognize and use your strong points, become aware of your limitations, and, as a result of this, know how to make your own plan of action. One of the lecturers of Information Technology will be assigned to be your study career coach. We will discuss your study progress, your possibilities, your competence development, your choices and, if necessary, study hampering factors. Your coach will support you in this, but you yourself are responsible for your own learning process, so an active role on your part is expected.</p> <p>Study career coaching will continue throughout all four study years. There are two guides: one for the foundation course and one for the main phase. Study career coaching is both an individual process and a group, collaborative process.</p> <p>The program of the final year is twofold. One part is aimed at preparing for your thesis project; the other goal is to get more insight in your own personal development and the competences required by the future professional field. For this purpose, some educational games will be used to practice those soft skills in a relaxed and non-confrontational setting.</p>	
Learning outcomes	<p>8.3.2 - Direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other things.</p> <p>8.3.3 - Demonstrate an appropriate professional attitude taking relevant ethical aspects into account.</p>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

## Assessment: Study Career Coaching 6 (SCC) - 3712IT425A

Assessment objectives/criteria	After successfully completing this module, the student: <ul style="list-style-type: none"><li>■ shows insight in the path of personal and professional development followed in the past and the road ahead (8.3.2);</li><li>■ demonstrates professional attitude when applying for a thesis project or job (8.3.3);</li><li>■ makes an informed choice for a graduation project that contributes to their future career (8.3.2).</li></ul>	
Details of assessments	This course is assessed by a combination of small reports on the educational games and other documents such as a letter of application and a resume.	
Strategies and teaching activities	Classes consist of lectures and educational games. Individual meetings with the SCC coach (SCC-interviews) are organized when necessary. Students independently visit the HBO-I event and acquire information from at least three different companies. Assignments are completed at home and need to be handed in through Moodle.	
Compulsory attendance (See also Article 115 TER)	No	Individual sessions and presentations have compulsory attendance
Permitted aids	Any	

## Cryptography - 3711IT423Z

Content of unit of study	Cryptography can be considered as part of Information Security. Cryptography can be found everywhere: Web browsers, on-line banking, wireless lan's, e-mail programs, cell phones, bank cards, RFID tags etc. Individual users, businesses and organizations worldwide can only communicate in a secure way over open (= unsafe) networks if cryptographic tools are used. Encryption, digital signatures, password-based authentication, are some of the basic cryptographic techniques to achieve secure communication and to prevent hackers and attackers to break into computer systems, steal information, change data etc. Cryptography plays an important role in the defense against such attacks, and that's why this course deals almost exclusively with studying cryptography and the underlying mathematics.	
Learning outcomes	<ol style="list-style-type: none"><li>1. 1.3.1 Analyse the accuracy and the value of a mathematical model.</li><li>2. 2.3.1 Select a mathematical model and tailor it to a complex problem.</li><li>3. 2.2.1. Tailor a complex given mathematical model to a problem.</li></ol>	
Requirements for participation in units of study (See also Article 29 TER)	None	
Specific details	None	

## Assessment: Cryptography - 3711IT423A

Assessment objectives/criteria	<ul style="list-style-type: none"><li>■ ( 1.1.1 ) understanding Cryptography by historical evolution</li><li>■ ( 2.3.1 ) applying symmetric ciphers: block ciphers and stream ciphers ( DES and AES )</li><li>■ ( 2.3.1 ) applying asymmetric ciphers: RSA, DHKE, Elgamal Encryption</li><li>■ ( 1.3.1 ) analyzing a problem for the right cipher</li><li>■ ( 1.3.1 ) evaluating the security of the chosen cipher</li></ul>	
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Details of assessments	Written Exam	
Strategies and teaching activities	Lectures	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

## Term 2

# Project Big Data - 3711IT421Z

Content of unit of study	Huge amounts of data are being collected by companies, governments, and individuals alike. Within these data a wealth of information is hidden, that has the potential to improve both business and quality of life. However, uncovering this information is like finding the proverbial needle in the data haystack. In this projects students are faced with a real-life data set and are challenged to store, transform, mine, and interpret it until it reveals its true potential.	
Learning outcomes	<ul style="list-style-type: none"> <li>■ Analyze the requirements for a big data environment. (1.3.4)</li> <li>■ Identify the business objectives of a data science project. (1.3.5)</li> <li>■ Design a Big Data environment. (2.3.4)</li> <li>■ Select suitable data mining methods for a complex data science problem. (2.3.5)</li> <li>■ Build, test and deliver a Big Data environment. (3.3.3)</li> <li>■ Build, evaluate, and deliver a predictive model based on one or more complex data sets. (3.3.4)</li> <li>■ Apply data-driven methods for monitoring processes or systems. (4.1.4)</li> <li>■ List and select project methods and software development methods. (5.1.1)</li> <li>■ Create, track and update a project plan. (5.1.2)</li> <li>■ Perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies. (5.1.3)</li> <li>■ Consult effectively and efficiently with those involved. (5.1.4)</li> <li>■ Allocate and delegate tasks within a project. (5.1.5)</li> <li>■ Create a recommendation based on substantiated arguments. (6.2.1)</li> <li>■ Communicate effectively, both orally and in writing, with people of various ranks. (6.2.2)</li> <li>■ Create an advisory report according to the guidelines. (6.2.3)</li> <li>■ Select and apply relevant, trustworthy, and recent sources to get a better understanding of the research question and subquestions. Sources need to be varied and of high enough level. (7.3.1)</li> <li>■ Provide multiple solutions to encountered problems, make an informed choice for a solution, and formulate recommendations for future (research) steps. (7.3.2)</li> <li>■ Determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives. (7.3.3)</li> <li>■ Reflect critically on the planned approach and actual implementation of a study. (7.3.4)</li> <li>■ Making a theoretically substantiated choice for research methods to answer the research questions. (7.3.5)</li> <li>■ Reflect critically on the choices made in a study and describe the consequences of those choices. (7.3.6)</li> <li>■ Collaborate effectively in an intercultural (project) team in a multidisciplinary environment. (8.3.1)</li> <li>■ Direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other things. (8.3.2)</li> <li>■ Demonstrate an appropriate professional attitude taking relevant ethical aspects into account. (8.3.3)</li> <li>■ Communicate effectively in a multidisciplinary, international, and intercultural environment. (8.3.4)</li> <li>■ Contribute to the creation of a safe and respectful work environment. (8.3.5)</li> <li>■ Perform management tasks (within a project team). (8.3.6)</li> </ul>	
Requirements for	None	

participation in units of study (See also Article 29 TER)	
Specific details	None

### Assessment: Project Big Data - 3711IT421A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>▪ model a real-world problem as a big data task;</li> <li>▪ perform exploratory data analysis on a real-world data set;</li> <li>▪ select a suitable data storage and analysis environment for a data science project;</li> <li>▪ select relevant data preprocessing techniques;</li> <li>▪ select relevant data mining techniques;</li> <li>▪ manage and store large amounts of data in a such a way that it becomes ready for analysis;</li> <li>▪ integrate data from multiple sources;</li> <li>▪ apply data preprocessing techniques using data mining software;</li> <li>▪ apply and evaluate data mining techniques using data mining software;</li> <li>▪ make recommendations for optimization of a product, service, or process based on results of data analysis;</li> <li>▪ effectively manage a big data project using suitable project management methods;</li> <li>▪ report on a big data project in a project report and a presentation;</li> <li>▪ select relevant, trustworthy, and recent sources to substantiate choices;</li> <li>▪ effectively collaborate in a research team;</li> <li>▪ reflect critically on the setup, implementation, and outcomes of a big data project.</li> </ul>	
Details of assessments	The grade will be based on the quality of the research and the report, and the individual performance of the student.	
Strategies and teaching activities	Instructions and group work.	
Compulsory attendance (See also Article 115 TER)	Yes	<p>During a project, visible execution and performance of vital skills such as mutual cooperation, communication with and to stakeholders and giving and receiving feedback and acting accordingly upon as such, form part of the examining and grading. For this reason, active participation and attendance is mandatory and hence needs to be fulfilled by the student to meet the criteria to be eligible for a positive marking. These criteria have been set at 80%.</p> <p>By setting the criteria at 80% (and not a full 100%) allows the student to fail attendance for a limited number of meetings caused by illnesses or other inconveniences, without facing serious consequences.</p> <p>These criteria have been explicitly stipulated for this project in the project description, leaving no room for ambiguous interpretations at the start of the project.</p>
Permitted aids	All	

## Business Intelligence - 3715IT422Z

Content of unit of study	<p>Business Intelligence ( and Data warehouse) is a collection of technologies aimed at enabling executives, managers or business analysts to make better and faster decisions. The right information in the right place at the right time with the right cost in order to support the right decision.</p> <p>This course will not only focus on this classical after-the fact business intelligence, but also on new models of business intelligence. Being the conceptual backbone of business intelligence, the analysis and design of data warehouses will be discussed. Different architectural solutions and connected components and modelling techniques will be discussed.</p>
Learning outcomes	Analyze, design and research

Requirements for participation in units of study (See also Article 29 TER)	None
Specific details	None

### Assessment: Business Intelligence - 3715IT422A

Assessment objectives/criteria	<ul style="list-style-type: none"> <li>■ Fundamental Concepts of BI</li> <li>■ Data quality and visualisation</li> <li>■ Data warehouse architecture</li> <li>■ Relational &amp; Multidimensional design</li> <li>■ ETL techniques</li> <li>■ Data visualisation</li> </ul>	
Details of assessments		
Strategies and teaching activities	Class will be theoretical. Students learn the ideas behind important BI and BI related concepts.	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All available relevant sources	

## Emerging Technologies - 3715IT424Z

Content of unit of study	<p>Information Technology and Computer Sciences are strongly developing fields, where new technologies can change the landscape in a few years, and it can be hard to predict what technologies are staying to be influential and which ones will not. Some examples of the past are:</p> <ul style="list-style-type: none"> <li>■ Personal computers ("There is no reason anyone would want a computer in their home." Ken Olsen, founder of Digital Equipment Corporation, 1977)</li> <li>■ Web shops ("So how come my local mall does more business in an afternoon than the entire Internet handles in a month?" Andrew Keen, 2008)</li> </ul> <p>While it is hard to predict the exact effects of new technologies on society and economy, it often is clear they will have it. Therefore, it is a good thing for people acting on the frontier of IT and CS to understand some of the emerging technologies, how to deal with them and how to estimate which ones are relevant to study.</p> <p>This course will give insight in some of the currently emerging technologies which can be expected to have a profound influence on the field and on society as a whole. Students will work with scientific papers to understand them and will implement them in a case study.</p> <p>Because of the nature of this course, details about content and assessment will be published shortly before the start of the course.</p>
Learning outcomes	<p>2.3.3 - Design an app, application or information system suited to the existing or desired environment.</p> <p>3.3.1 - Implement the application of a designed algorithm or mathematical model.</p> <p>3.3.2 - Build, test and deliver an app, application or information system that fits within the existing or desired environment.</p> <p>7.3.3 - Determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives.</p> <p>8.3.2 - Direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other things.</p>



Requirements for participation in units of study (See also Article 29 TER)	The student needs to have passed the internship (Year 3 of the programme)
Specific details	None

### Assessment: Emerging Technologies - 3715IT424A

Assessment objectives/criteria	<p>After successfully completing this course, the student can:</p> <ul style="list-style-type: none"> <li>Collect and understand relevant information on new technologies (8.3.2)</li> <li>Develop and express a substantiated opinion on the viability of the new technology (7.3.3)</li> <li>Analyze the technology to understand the architecture and implementation (3.3.2)</li> <li>Implement the technology in an existing infrastructure (2.3.3)</li> <li>Adapt or add to the technology to make it fit for purpose (3.3.1)</li> </ul>	
Details of assessments	<p>The assessment consists of two parts:</p> <ul style="list-style-type: none"> <li>A paper on the chosen technology stack (60%)</li> <li>A practical assignment where the student has to adapt a (demonstration model of) the chosen technology to achieve a specified purpose (40%)</li> </ul>	
Strategies and teaching activities	<p>Part of the time in class is used to discuss the concepts behind the technologies. As using the technology adds understanding of it, significant time will be spent to set up the blockchain networks and using them.</p> <p>Another activity is to analyse the technology – for example source code - in order to understand the architecture and implementation and to see what effects changing part of the implementation will have, as well as adding and changing to it to get the desired functionality.</p>	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	<p>For the written exam: all hardcopy materials brought to the exam, no electronic devices</p> <p>For the practical assignment: all</p>	

## Distributed Systems and Parallel Computing - 3712IT412Z

Content of unit of study	<p>Working with big data involves applying complex algorithms to large data sets. Processing time and memory requirements make it infeasible to run these processes on a single machine. In this course students learn how processing can be distributed over multiple machines. In the first part we focus on different distributed infrastructures, such as clusters and clouds. Students learn the advantages and disadvantages of the various solutions and get hands-on experience setting up a cluster. The second part addresses parallelization of algorithms. We address the different types of parallelization and implement a parallel algorithm in the SPARK framework.</p> <p>As distributing computation involves redesigning both hardware and software, this course requires basic knowledge of networking, as well as algorithms and data structures and software development.</p>	
Learning outcomes	<ul style="list-style-type: none"> <li>Perform a complexity analysis of an algorithm using mathematical demonstration. (1.3.2)</li> <li>Design an algorithm for a complex problem. (2.3.2)</li> <li>Design a Big Data environment. (2.3.4)</li> <li>Implement the application of a designed algorithm or mathematical model. (3.3.1)</li> <li>Build, test and deliver a Big Data environment. (3.3.3)</li> </ul>	
Requirements for participation in units	None	



of study (See also Article 29, TER) Specific details	None
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## Assessment: Distributed Systems and Parallel Computing - 3712IT412A

Assessment objectives/criteria	After successfully completing this module, the student is able to: <ul style="list-style-type: none"> <li>■ explain the various ways to distribute computation;</li> <li>■ set up a small scale cluster;</li> <li>■ estimate the performance gains of parallelizing a computation task;</li> <li>■ effectively parallelize an algorithm within the Spark framework;</li> <li>■ implement a parallel algorithm using Spark;</li> <li>■ run a job in a distributed environment.</li> </ul>	
Details of assessments	Portfolio that documents case studies on parallel computing they worked on	
Strategies and teaching activities	Lectures and lab sessions	
Compulsory attendance (See also Article 115 TER)	No	It is compulsory to attend at least two classes in which students work on assignment 1, to ensure sufficient contribution to the group work.
Permitted aids		

## Semester 2

## Individual Project (Thesis) - 3710IT444Z

Content of unit of study	During the Thesis Project the student carries out an applied research project in a company setting. The aim of this project is to show that the student can independently set up and conduct a research project and write a thesis about the results. The project requires the student not only to integrate various knowledge areas studied in school, but also to independently master topics needed for the project that were not learned in school. At the same time the student has to show they can function within the company at an adequate (engineering) level
Learning outcomes	5.1.1 List and select project methods and software development methods. 5.1.2 Create, track and update a project plan. 5.1.4 Consult effectively and efficiently with those involved. 6.2.1 Create a recommendation based on substantiated arguments. 6.2.2 Communicate effectively, both orally and in writing, with people of various ranks. 6.2.3 Create an advisory report according to the guidelines. 7.3.1 Select and apply relevant, trustworthy, and recent sources to get a better understanding of the research question and subquestions. Sources need to be varied and of high enough level. 7.3.2 Provide multiple solutions to encountered problems, make an informed choice for a solution, and formulate recommendations for future (research) steps. 7.3.3 Determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives. 7.3.4 Reflect critically on the planned approach and actual implementation of a study. 7.3.5 Making a theoretically substantiated choice for research methods to answer the research questions. 7.3.6 Reflect critically on the choices made in a study and describe the consequences of those choices. 8.3.1 Collaborate effectively in an intercultural (project) team in a multidisciplinary environment. 8.3.2 Direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other things.

	8.3.3 Demonstrate an appropriate professional attitude taking relevant ethical aspects into account. 8.3.4 Communicate effectively in a multidisciplinary, international, and intercultural environment. 8.3.5 Contribute to the creation of a safe and respectful work environment.
Requirements for participation in units of study (See also Article 29 TER)	A student is allowed to start the Thesis Project only when: <ul style="list-style-type: none"> <li>■ he/she has completed the foundation programme (year 1);</li> <li>■ he/she has achieved 190EC</li> <li>■ he/she has completed the internship</li> <li>■ the thesis project proposal has been approved by the graduation board (Note: the thesis project <u>always</u> only starts <u>after</u> the approval, never before.)</li> </ul>
Specific details	None.

### Assessment: Individual Project (Thesis) - 3710IT444A

Assessment objectives/criteria	The student can: <ul style="list-style-type: none"> <li>■ independently acquire new knowledge and skills;</li> <li>■ function in a professional environment;</li> <li>■ apply knowledge and skills learned at school in a real-world situation;</li> <li>■ set up and conduct a medium sized research project;</li> <li>■ present the outcomes of a research project in a presentation;</li> <li>■ write a thesis about the outcomes of a research project.</li> </ul>	
Details of assessments	The grade will be based on the thesis and the final presentation. The impression of the company and the school supervisor of the work of the student are taken into account.	
Strategies and teaching activities	The project is conducted within the company. The student is supervised by a school supervisor and a company supervisor and has regular meetings with both. In additions, all students doing their individual projects attend thesis seminars organized at school.	
Compulsory attendance (See also Article 115 TER)	Yes	Assessment is partly based on the professional attitude of the student at the internship organisation
Permitted aids	All	