Study Program 2021 - 2022
Mathematical Engineering
Amsterdam/Diemen

Courses open to exchange students

18-01-2021

Introduction

This document describes the courses open for exchange students in the Mathematical Engineering program. The program may be subject to change.

An exchange student can compose his/her own program choosing any courses described in this document. However, when choosing courses from higher years we expect students to have the knowledge and skills from previous years. Also, when selecting courses from different years, the courses might have an overlap in scheduling making it difficult to attend both. Furthermore, the sending university (home university of the student) may impose restrictions on the program.

One term consists of 10 weeks.
A program for a semester of 20 weeks (2 terms) consists of 30 credits (15 credits per term).
In this document you can see which course will be scheduled in which term.
- Term 1: September - November
- Term 2: November - January
- Term 3: February - April
- Term 4: April – June/July

Ms. Margje Penning is the coordinator of the Exchange Students at Mathematical Engineering Amsterdam/Diemen. If you have any questions about the exchange program, if you want to consult about your possible program or if you need more information, please feel free to contact her.
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Table of content

Description of Units of Study

Year 1

Term 1

IT Essentials - 3719IT111Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 1	IT Essentials		No	5
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
IT Essentials, 3719IT111A		Grade (10-100)	55	100%	140
Content of unit of study	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. 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. 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.				
Phase of Bachelor's programme	Suitable for the profession				
Learning outcomes	After successfully completing this module, the student is able to: ▪ Explain the general structure and working of a computer system (8.1.3)				

	▪ Plan and execute preventive and corrective maintenance on a simple IT infrastructure (4.1.3) ▪ Select relevant sources on hardware, middleware and software aimed at a specific domain (7.1.1) ▪ Design a specialized computer system for a given purpose (2.1.3) ▪ Install, configure and troubleshoot a personal computer or laptop and its connection to a local network and peripherals (3.1.2)	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	2.1.3 - Create the design of a delimited part of an app, application or information system using a given modelling technique. 3.1.2 - Build, test and deliver a prototype of an app, application or information system. 4.1.3 - Use management protocols and systems for data management. 7.1.1 - Select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background. 8.1.3 - Apply knowledge, insights and skills.	
Details of assessments	Written with test session	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. The course is finalized with two exams: ▪ An exam on the computer to test theoretical knowledge and understanding. ▪ A practical test on computer components, electronics and troubleshooting to test practical skill.

Strategies and teaching activities	Classes usually starts with a speed presentation of the theory that week (going over all chapters that week) 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. After a class, students have one week to do the chapters tests for that week. These are part of the final grade as well.	
Contact hours for strategies and teaching activities	21	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids		

English 1 - 3713IT114Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 1	Professionalization		Yes	2
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
English 1, 3713IT114A		Grade (10-100)	55	100%	56
Content of unit of study	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. 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. 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. English 1: this course aims at bringing your reading level up to C1 and level of writing to level B1.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	8.1.1 Communicate effectively, both orally and in writing.
Requirements for participation in units of study (See also Article 29 TER)	None.
Compensation (See also Article 127 TER)	No
Specific details	Prerequisites: none, except that the level of English should at least be at B1CEF.
Assessment objectives/criteria	▪ **<u>Assessment criteria</u>** **Components** - Accurately uses correct business letter format (heading, greeting, introduction, body, closure, signature, enclosure, and copy) **Content** - Letter clearly states the purpose - uses Appropriate explanations or facts used to support the main idea ¨ **Appearance** - using correct spacing, font, and format and lay-out **Language Usage** - Accurate use of punctuation and grammar, vocabulary at B1/B2 level, No spelling errors

	PRESENTATION **Assessment criteria** The presentation is assessed on the following criteria: ▪ Used aids in media, such as PowerPoint, Prezi, Rocket Slide etc., attractiveness of the presentation ▪ Topic, complexness or execution of the assignment ▪ Pronunciation ▪ Structured presentation: introduction, body, conclusion, sign-posting, presentation techniques, attitude in front of the class, meeting conventions for presentations ▪ Interaction with class during questions 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.	
Details of assessments	Written with test session	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)	
Contact hours for strategies and teaching activities	31	
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

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 1	Software Engineering		No	3
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Programming with Python 1, 3718IT113A		Grade (10-100)	55	100%	84
Content of unit of study	Good programming is about logical structuring and algorithmic thinking. It means that algorithms have to be designed in a systematic and structured way, in order to make the code easily readable and well maintainable.				
Phase of Bachelor's programme	Suitable for the profession				
Learning outcomes	Analysis, design and implementation				
Requirements for participation in units of study (See also Article 29 TER)	None				
Compensation (See also Article 127 TER)	No				
Specific details	one				
Assessment objectives/criteria					
	The student: ▪ applies the 'divide and conquer' principle correctly dividing code between files and functions (2.1.3); ▪ uses a proper lay-out and informative comment lines (3.1.2); ▪ can construct a Nassi Schneidermann Diagram (NSD) from a given problem choosing the correct control structures and nesting the structures correctly (1.1.3); ▪ can build a simple Python program (3.1.1).				

	▪ understands and applies variables and datastructures correctly in Python (3.1.2); ▪ applies and creates functions correctly (use of parameters and return, passing by reference or value) (3.1.2); ▪ uses given functions correctly and knows how to find information on predefined Python functions and libraries (3.1.2).	
Details of assessments	Written with test session	
Strategies and teaching activities	The contact hours are combined lectures with exercises and lab-sessions where the student will work on programming assignments. The students are expected to prepare these sessions by studying the chapters and by making the exercises as indicated in the week overview.	
Contact hours for strategies and teaching activities	45	Lectures, lab work, self-study and working on assignments
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	N.A	

Precalculus - 3714IT116Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 1	Mathematics		Yes	4
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Precalculus, 3714IT116A		Grade (10-100)	55	100%	112

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 during your 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 certainly be covered: fractions, basic algebra, function, first and second degree equations, logarithms and exponentials. Continuing the course will introduce two important concepts, namely function, and limit.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Analyze and Realize
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	▪ the student can analyse and can conduct computations with reasonable numeracy and accuracy ▪ the student can conduct computations with fractions and roots, with numbers and variables ▪ the student can factorize a polynomial and can conduct a long division of a polynomial with variables ▪ the student can recognize mathematical functions; the student can compute and apply properties of functions ▪ the student can solve types of (systems of) equations and inequalities

	▪ the student can compute and apply properties of simple trigonometric functions; the student can solve simple trigonometric equations ▪ the student can compute properties of logarithmic and exponential functions; the student can solve with these functions simple equations	
Details of assessments	Written with test session	Written exam.
Strategies and teaching activities	Teaching method: tutorials, without calculator The teacher gives a short explanation of the theory, and explains homework questions The student practices problems during tutorials and makes homework according to the schedule, prepares questions for the teacher, practices with the trial exam **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**	
Contact hours for strategies and teaching activities	45	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Term 2

Calculus 1 - 3714IT121Z

Academic year	Term	Name of examination component	Qualitative requirement BSR	Study load in credits
1	Term 2	Mathematics	No	4

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Calculus 1, 3714IT121A	Grade (10-100)	55	100%	112

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.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Analyze and Realize
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	▪ apply rules (product-, quotient- and chain rule) for differentiation of (quotients of) polynomials, trigonometric functions, exponential functions and logarithmic functions. ▪ apply rules (substitution, integration by parts, using partial fractions) for integration of (quotients of) polynomials, trigonometric functions, exponential functions and logarithmic functions. ▪ determine extreme values and inflection points of functions ▪ produce an equation of tangent and normal.

Details of assessments	Written with test session	Written exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	45	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Programming with Python 2 - 3718IT122Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 2	Software Engineering		No	3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Programming with Python 2, 3718IT122A		Grade (10-100)	55	100%	84
Content of unit of study	This course continues on the course Python 1. Good programming is about logical structuring and algorithmic thinking. It means that algorithms have to be designed in a systematic and structured way, in order to make the code easily readable and well maintainable. This course will go into the more advanced features of programming in Python. Subjects covered are datatypes, some object oriented programming, input/output, errors and exceptions.				
Phase of Bachelor's programme	Suitable for the profession				
Learning outcomes	Analysis, design and implementation.				
Requirements for participation in units of	None, but it is advised to do Python 1 first.				

study (See also Article 29 TER)	
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully completing this course, the student: ▪ uses a proper lay-out and informative comment lines (3.1.2), ▪ 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), ▪ 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). ▪ can translate NSD or flow diagram to Python functions and vice versa (3.1.1), ▪ uses control structures correctly in Python (2.1.3); ▪ correctly creates and uses functions (3.1.2), ▪ understands and applies the division of responsibilities between files and functions (2.1.3) ▪ understands and correctly uses tuples, lists, dictionaries and sets in Python (3.1.2), ▪ can open, close, read, write and append in text-files and in binary-files (3.1.2), ▪ understands the difference between errors and exceptions and creates code to create and handle exceptions effectively (3.1.2) ▪ understands the basics of object orientation and applies it correctly in Python (3.1.2), ▪ knows how and where to find information on Python and can find and import Python libraries when needed (3.1.1)
Details of assessments	Written with test session

Strategies and teaching activities	The contact hours are combined lectures with exercises and lab-sessions where the student will work on programming assignments (4.5 hours each week). The students are expected to prepare these sessions by studying the chapters and by making the exercises as indicated in the week overview.	
Contact hours for strategies and teaching activities	45	Lectures, lab work, self-study and working on assignments
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	N.A	

Project Casual Graphics - 3718IT123Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 2	Software Engineering		No	4
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Project Casual Graphics, 3718IT123A		Grade (10-100)	55	100%	112
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).				
Phase of Bachelor's programme	Suitable for the profession				
Learning outcomes	Analysis, design and implementation				
Requirements for participation in units	None				

of study (See also Article 29 TER)		
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	The student is able to: ▪ Create, track and update a project plan (5.1.2) ▪ Manage a project and maintain process quality (5.1.3) ▪ Consult effectively and efficiently with those involved (5.1.4) ▪ Allocate and delegate tasks (5.1.5) ▪ 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) ▪ Reflect on own behavior and give and receive feedback appropriately (8.1.2) ▪ Apply knowledge, insights and skills (8.1.3) and demonstrate an appropriate study attitude (8.1.4) ▪ Communicate effectively (, 6.1.2),(8.1.5) and contribute to a respectful environment (8.1.6) ▪ Meet deadlines (8.1.7) ▪ Demonstrate the ability to deliver sufficient product quality using Python (3.1.2) ▪ Translate mathematical relations in coding and a graphic representation of a fractal (2.1.1), (3.1.1) ▪ Apply recursive functions and complex numbers (2.1.2) ▪ Build a simple application with user interaction giving a graphical representation of a fractal (1.1.3),(2.1.3)	
Details of assessments	Other Method	Your final grade will be composed of a group product and process grade and an individual grade.

	without test session	In case of insufficient participation or not functioning of the project group the project can be resit in the next academic year.
Strategies and teaching activities	Workshops, project and tutor meetings	
Contact hours for strategies and teaching activities	32	Workshops and group 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	

Statistics 1 - 3719IT125Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 2	Statistics		No	3
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Statistics 1, 3719IT125A		Grade (10-100)	55	100%	84

Content of unit of study	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. 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.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Analyze, Design
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	

Assessment objectives/criteria	After successfully completing this module, the student is able to: - Explain the basic goals and concepts of statistics; - Describe advantages and disadvantages of various data collection methods; - Create an appropriate graphical representation of a data set; - Compute descriptive statistics for a data set; - Perform a linear regression analysis on two variables; - Use Python for descriptive statistics.	
Details of assessments	Written with test session	Assessment is based on a written exam and a programming assignment.
Strategies and teaching activities	Lectures, exercises, and practical work	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	Calculator	

Term 3

Research 1 - 3720IT131Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 3	Research		No	3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Research 1, 3720IT131A		Grade (10-100)	55	100%	84

Content of unit of study	In any but the most simple 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. 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 a solution which is unmaintainable, does not give the best way to solve the problem, turns out to be the wrong answer, or is ethically unacceptable. 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.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Research and professionalize
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Describe and identify the phases in a structured applied research ▪ Create a summarized plan for each phase in a given, structured research situation ▪ Use a scientifically sound way of reasoning to draw or reject a conclusion ▪ Identify the kind of scientific reasoning needed or neglected in a given situation

	▪ Assess the ethical implications in a research proposal and give your reasoned opinion on it.	
Details of assessments	Written with test session	The topics of week x will be assessed in week x+1 with a small written test. The topics of the last week are tested in the same week. No partial grades are given; all tests together give a final grade. No resits are given for those partial tests. When failing the exam given with those partial tests, a full written exam covering all topics is given in the exam term. This is the resit for the exam.
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. This will be alternated with short exercises. Between classes, assignments are given to fortify understanding of the subjects.	
Contact hours for strategies and teaching activities	17	When possible, partial tests are given just before or after a class.
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

Academic year	Term	Name of examination component	Qualitative requirement BSR	Study load in credits
1	Term 3	Data	No	3

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
DBMS 1, 3720IT134A	Grade (10-100)	55	100%	84

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.	
Phase of Bachelor's programme	Suitable for the profession	
Learning outcomes	Analyze and realize	
Requirements for participation in units of study (See also Article 29 TER)	none	
Compensation (See also Article 127 TER)	No	
Specific details		
Assessment objectives/criteria	▪ the student can analyze a relational database diagram (1.1.3) ▪ the student is able to write a SQL query to retrieve desired information from the database (1.1.3) ▪ the student is able to write a SQL command to insert, update or delete data from the database (1.1.3) ▪ The student understand the concept of logical integrity (1.1.4)	
Details of assessments	Written with test session	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.	
Contact hours for strategies and teaching activities		During the lessons theory will be explained and problem solving will be done.
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	MySQL database	

Linear Algebra - 3719IT133Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 3	Linear Algebra		No	4
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Linear Algebra, 3719IT133A		Grade (10-100)	55	100%	112
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 class will introduce Vectors and Matrices. Basic topics are: Determinants, Inverse, and Eigenvalue. Matlab will be the software tool for calculation help.				
Phase of Bachelor's programme	Suitable for the profession				
Learning outcomes	Analyze and Realize				
Requirements for participation in units of study (See also Article 29 TER)	None				

Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Calculate operations for Matrices and its Determinant ▪ Solve linear equations by using Matrices and/or Determinants ▪ Calculate operations for Vectors ▪ Solve simple Eigenvalue problems	
Details of assessments	Written with test session	Written Exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	None	

English 2 - 3713IT144Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 3	Professionalization		No	2
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
English 2, 3713IT144A		Grade (10-100)	55	100%	56
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 acquiring new English vocabulary (formal vs informal), reviewing English grammar and will subsequently focus on speaking and				

<table>
<tr><td></td><td>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.
English 2: this course aims at bringing your reading level up to C1 and level of writing to level B2.</td></tr>
<tr><td>Phase of Bachelor’s programme</td><td>Suitable for the profession</td></tr>
<tr><td>Learning outcomes</td><td>8.1.1 Communicate effectively, both orally and in writing.</td></tr>
<tr><td>Requirements for participation in units of study (See also Article 29 TER)</td><td>None.</td></tr>
<tr><td>Compensation (See also Article 127 TER)</td><td>No</td></tr>
<tr><td>Specific details</td><td>Prerequisites: Having successfully completed ENG1 is preferred.
Students are expected to have full knowledge of all aspects dealt with in this course.</td></tr>
<tr><td>Assessment objectives/criteria</td><td>▪ 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></table></td></tr>
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		Grammar & Proofreading	Displays proper usage of formal, grammatical English. Shows evidence of careful proofreading.
	▪		
Details of assessments	Written with test session	Sz, schriftelijk zonder toetszitting / Written assignments without a formal test sitting. In class presentation (P/F) a pre-requisite to the final grade.	
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)		
Contact hours for strategies and teaching activities	31		
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

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 3	Statistics		No	2
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Statistics 2, 3720IT135A		Grade (10-100)	55	100%	56

Content of unit of study	In the first part of this course the focus will lie on probability theory. It will start with the basic axioms of 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 the confidence interval and the Student's t-distribution.	
Phase of Bachelor's programme	Suitable for the profession	
Learning outcomes	Understanding concepts in probability and sampling theory	
Requirements for participation in units of study (See also Article 29 TER)	none	
Compensation (See also Article 127 TER)	No	
Specific details		
Assessment objectives/criteria	The student is able to Analyze a practical case in terms of probability theory or sampling theory or sampling theory.pability of the student to translate a practical problem into a probability related problem. (1.1.1, 2.1.1, 2.1.2)	
Details of assessments	Written with test session	The exam will consist of 5 or 6 questions about the theory larned.
Strategies and teaching activities	Classical explanantion of the theory, together with classical problem solving.	
Contact hours for strategies and teaching activities		During the lessons theory will be explained, immediately followed by exercises.

Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids		

ME learning challenge 1 - 3720IT136Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 3	Professionalization		No	1
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
ME learning challenge 1, 3720IT136A		Grade (10-100)	55	100%	28
Content of unit of study	The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education is 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. 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 year 1, 2 and 3. 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.	
Phase of Bachelor's programme	Suitable for the profession	
Learning outcomes	Management, Professionalization	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Define learning objectives for a learning task. ▪ Select suitable educational resources. ▪ Create a work plan for a learning task. ▪ Effectively develop professional competences at their study level by working according to a work plan. ▪ Collaborate effectively in a learning team. ▪ Communicate effectively with coaches and members of a learning team. ▪ Present the outcomes of a learning process. ▪ Reflect critically on the applied learning methods and learning process.	
Details of assessments	Other Method without test session	
Strategies and teaching activities	Group work	
Contact hours for strategies and teaching activities	32	
Compulsory attendance (See also Article 115 TER)	Yes	

Permitted aids	All

Term 4

Project Databases - 3719IT141Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 4	Data		No	4
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Project Databases, 3719IT141A		Grade (10-100)	55	100%	112

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).
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Analysis, design and implementation
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	
Assessment objectives/criteria	The student is able to: ▪ Create, track and update a project planning (5.1.2) ▪ Manage a project and maintain process quality (5.1.3) ▪ Consult effectively and efficiently with those involved (5.1.4)

	▪ Allocate and delegate tasks (5.1.5) ▪ 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) ▪ Reflect on own behavior and give and receive feedback appropriately (8.1.2) ▪ Apply knowledge, insights and skills (8.1.3) and demonstrate an appropriate study attitude (8.1.4) ▪ Communicate effectively (6.1.2),(8.1.5) and contribute to a respectful environment (8.1.6) ▪ Meet deadlines (8.1.7) ▪ Demonstrate the ability to deliver sufficient product quality using MySQL and Python (3.1.2) ▪ Translate a general user request in a feature list (1.1.3) ▪ Translate a feature list in a database design (1.1.4) and (2.1.4) ▪ Create the database and the connection with Python (3.1.3) ▪ Build a simple application with user interaction (2.1.3) ▪ Write a user manual of the application (4.1.2)	
Details of assessments	Other Method without test session	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	
Contact hours for strategies and teaching activities	32	Workshops and group 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	

DBMS 2 - 3714IT143Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 4	Data		No	3
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
DBMS 2, 3714IT143A		Grade (10-100)	55	100%	84
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. Databases are widely used to organize and store structured data and retrieve information. In the course DBMS1, students learned how to manipulate the data stored in a database and how to handle it to get information. The other side of				

	using a database management system is the ability to design, implement and optimize a database. The scope in this is quite broad; as a mathematical engineer, your focus will be on developing and optimizing the physical implementation rather than analyzing the data to be stored in the database. That does not mean you do not have to learn how to do a basic information analysis, however, in practice, the more complex data structures will be analyzed by a specialist, the results to be used by the engineer in designing the actual database. 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.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Design and Implementation
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Create a simple data model given a clear context and information need ▪ Transform the results of this information analysis to a database design

	▪ Optimize the database design in terms of consistency and performance ▪ Implement the database design in the MySQL DBMS ▪ Write MySQL triggers and stored procedures to support the usage of the database .	
Details of assessments	Written with test session	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.	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	A computer running the MySQL DBMS	

Statistics 3 - 3719IT144Z

Academic year	Term	Name of examination component		Qualitative requirement BSR	Study load in credits
1	Term 4	Statistics		No	3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Statistics 3, 3719IT144A		Grade (10-100)	55	100%	84
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.	
Phase of Bachelor's programme	Suitable for the profession	
Learning outcomes	Analysis, Design, Implementation	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	Calculator	
Assessment objectives/criteria	▪ Select an appropriate hypothesis test for a problem. ▪ Conduct a hypothesis test on one sample. ▪ Conduct a hypothesis test on two samples. ▪ Conduct a hypothesis test on categorical data. ▪ Conduct a hypothesis test on three or more means. ▪ Conduct a nonparametric hypothesis test. ▪ Interpret the meaning of a hypothesis test in the context of the original problem	
Details of assessments	Written with test session	
Strategies and teaching activities	Lectures and exercises	
Contact hours for strategies and teaching activities	24	
Compulsory attendance (See also Article 115 TER)	Yes	

Permitted aids	Calculator

Calculus 2 - 3714IT136Z

Academic year	Term	Name of examination component	Qualitative requirement BSR	Study load in credits
1	Term 4	Mathematics	No	4

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Calculus 2, 3714IT136A	Grade (10-100)	55	100%	112

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.
Phase of Bachelor's programme	Suitable for the profession
Learning outcomes	Analyze and Realize
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None

Assessment objectives/criteria	▪ Using Complex numbers for solving equations ▪ Solving simple Sequences and Series problems

	▪ Solving first and second order Differential equations ▪ Solving simple problems with Functions of more than one variable ▪ Analyzing and Finding a solution for Calculus problems with software products	
Details of assessments	Written with test session	Written Exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	45	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Year 2

Term 1

Software Engineering - 3719IT211Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 1	Software Engineering			4
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Software Engineering, 3719IT211A		Grade (10-100)	55	100%	112
Content of unit of study	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. 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. Where small application can be designed and implemented by a single developer, larger ones are developed by teams, quite often with members specializing in a certain field. Specific procedures and tooling needs to be used to keep track of the project status and to make sure code does not conflict with other code. This course addresses the systematic (agile) approach to the design and development of (large) IT systems. It will cover requirements analysis and design techniques with use case modeling and using a distributed version control system.				

Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
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. 4.1.1 - Set up and use a control system to support software development in a team setting. 4.1.3 - Use management protocols and systems for data management. 7.2.5 - Analyse requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Translate the information needs in the domain to functional specifications (1.2.3) ▪ Create a functional design of the information system in UML (2.2.3) ▪ Use a version control system to manage development with a team (4.1.1) ▪ Use an iterative software development process in a context suitable to it (4.1.3) ▪ Elucidate potential functionalities in a given problem domain (7.2.5)
Details of assessments	Written with test session

Strategies and teaching activities	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. A similar case study will be used on the exam, which will be made available for reading one week before the exam. 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. The last class revolves around using the GIT version control system in practice; this class will be hands-on and students need to bring a laptop with them.	
Contact hours for strategies and teaching activities	17	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids		

English 3 - 3719IT212Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 1	Professionalization			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
English 3, 3719IT212A		Grade (10-100)	55	100%	84
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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	6.2.1 Communicate effectively, both orally and in writing, with people of various ranks.
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
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 objectives/criteria	**Assessment criteria** **Criterion A: Use a process journal** ▪ demonstrate organizational skills showing time- and self-management ▪ communicate and collaborate with the supervisor ▪ demonstrate information literacy, thinking and reflection. **Criterion B: Define the goal** ▪ identify and explain a topic based on personal interest/Web Science topic ▪ justify one focus area of interaction as a context for the project ▪ outline a clear, achievable, challenging goal **Criterion C: Select sources** ▪ select varied, relevant sources to achieve the goal ▪ evaluate sources.

<table>
<tr><td></td><td colspan="2">Criterion D: Apply information
transfer and apply information to make decisions, create solutions and develop understandings in connection with the project’s goal.
Criterion E: Achieve the goal
evaluate the outcome/product against specifications for success.
<u>Presentation</u>
Assessment criteria
The presentation is assessed on the following criteria:
Used aids in media, such as PowerPoint, Prezi, Rocket Slide etc., attractiveness of the presentation
Topic, complexness or execution of the assignment
Pronunciation
Structured presentation: introduction, body, conclusion, sign-posting, presentation techniques, attitude in front of the class, meeting conventions for presentations
Interaction with class during questions</td></tr>
<tr><td>Details of assessments</td><td>Written with test session</td><td>Written assignment without a formal test sitting.
In class presentation (P/F)</td></tr>
<tr><td>Strategies and teaching activities</td><td colspan="2">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)</td></tr>
<tr><td>Contact hours for strategies and teaching activities</td><td>31</td><td></td></tr>
<tr><td>Compulsory attendance (See also Article 115 TER)</td><td>No</td><td></td></tr>
<tr><td>Permitted aids</td><td colspan="2">Individual paper – written outside of class aids and sources permitted.
Presentation: to be decided by student(s). (PowerPoint, Prezi, other)</td></tr>
</table>

Object Oriented Programming 1 - 3719IT213Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 1	Software Engineering			4
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Object Oriented Programming 1, 3719IT213A		Grade (10-100)	55	100%	112
Content of unit of study	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. 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. 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.				
Phase of Bachelor’s programme	In possession of the skills necessary for professionalisation				
Learning outcomes	2.2.3 - Design an app, application or information system, selecting a suitable modelling technique. 3.2. - 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	
Compensation (See also Article 127 TER)	No	
Specific details		
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Apply Java constructs in creating a basic application (3.2.2) ▪ Use both basic and advanced OO concepts in developing desktop software (3.2.2) ▪ Design classes according to industry-standard guidelines (2.2.3) ▪ Create technical documentation on your implemented code (4.1.2)	
Details of assessments	Written with test session	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	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. Any decent application needs forethought. Throughout the course this will be supported by learning how to draw UML Class Diagrams. Most of the time spent in class is meant for supported exercise, as learning to develop software means practicing a lot.	
Contact hours for strategies and teaching activities	28	

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

Academic year	Term	Name of examination component			Study load in credits
2	Term 1	Statistics			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Statistics 4, 3719IT214A		Grade (10-100)	55	100%	84
Content of unit of study	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. 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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Analysis, Design, Implementation				
Requirements for participation in units of study (See also Article 29 TER)	None				
Compensation (See also Article 127 TER)	No				
Specific details					
Assessment objectives/criteria					

	▪ Verify the conditions of linear, multiple, and logistic regression models. ▪ Build linear, multiple, and logistic regression models by means of statistical software. ▪ Apply variable selection for building multiple regression models. ▪ Conduct inference on linear, multiple, and logistic regression models. ▪ Interpret estimated coefficients in linear, multiple, and logistic regression models. ▪ Understand the working of principle component analysis. ▪ Apply principal component analysis by means of statistical software. ▪ Interpret the results of principle component analysis.	
Details of assessments	Written with test session	
Strategies and teaching activities	Instructions, exercises, and lab sessions	
Contact hours for strategies and teaching activities	24	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Calculator	

Term 2

Geometry - 3713IT223Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 2	Mathematics			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Geometry, 3713IT223A		Grade (10-100)	55	100%	84

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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analyze and Realize
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	▪ Solving Geometric problems by construction with straightedge and compass ▪ Applying Euclid's approach to solve Geometric problems ▪ Solving Geometric problems by coordinates ▪ Applying Vectors to solve Geometric problems ▪ Solving Geometric problems by projective geometry

Details of assessments	Written with test session	Written Exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	24	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Straightedge (Ruler), Pair of Compasses	

Object Oriented Programming 2 - 3719IT222Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 2	Software Engineering			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Object Oriented Programming 2, 3719IT222A		Grade (10-100)	55	100%	84
Content of unit of study	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. 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 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.				

	After successfully finishing this module, the student will be able to create a fully functional Java application with a graphical user interface.	
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation	
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	
Compensation (See also Article 127 TER)	No	
Specific details		
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Design an application in a way fitting with the purpose and environment of it (2.2.3) ▪ Apply Design Patterns to make an application maintainable (2.3.3) ▪ Use the Collections framework and Generics and adapt it to the specific needs (3.2.1) ▪ Create a functional GUI with JavaFX (3.2.2)	
Details of assessments	Written without test session	
Strategies and teaching activities	Class usually starts with an explanation of the subject for that day, supported by small code examples where useful. After this introduction,	

	students practice using the exercises in the Exercise Manual, getting support and feedback from the teacher. At the start of the term an assignment is given on which students work during the course. They can ask for general feedback during the term. Students are also allowed to help each other, as long as they do not copy code, only concepts and ideas. The final result is handed in at the beginning of the first exam week and used to determine the final grade.	
Contact hours for strategies and teaching activities	21	
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

Academic year	Term	Name of examination component			Study load in credits
2	Term 2	Software Engineering			5
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Project Application Development, 3713IT221A		Grade (10-100)	55	100%	140
Content of unit of study	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. Even when choosing to create a mathematical model, several approaches remain viable. The engineer needs to choose between the options				

	available, and if 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. 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. 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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analyze, Design, Implementation, Maintain, Manage, Advise, Professionalize and Research
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully finishing this project, the student can: ▪ Use a version control system to coordinate the work within the team

	▪ Choose a software development method suitable to the situation at hand ▪ Analyze the math involved in real-life problems ▪ Transform the math to a software design ▪ Implement the design made in the previous step in software ▪ Create and maintain technical documentation for the application Besides these specific criteria, students will be assessed on general project skills (Advise, Professionalize and Research)	
Details of assessments	Other Method without test session	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. 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.
Strategies and teaching activities	Activities consist of general class feedback, group sessions and feedback and working as a group on the models, application and report.	
Contact hours for strategies and teaching activities	32	
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 80%. 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. 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	The student may use any means, provided that they do the project themselves, and the student must be clear in their source.	

Operations Research - 3713IT334Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 2	Mathematics			4
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Operations Research, 3713IT334A		Grade (10-100)	55	100%	112
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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Analyse,Design,Advise				

Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ (1.3.1) Investigate a practical problem by a model ▪ (2.3.1) Solve a practical problem by a model with a Mathematical programming approach ▪ (1.3.1) Research the influences of the constraints for the effect of the solution ▪ (6.2.1) Recommend a decision based on the calculated solution in the Model	
Details of assessments	Written with test session	Written exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Term 3

Numerical Analysis - 3719IT231Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Mathematics			3
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Numerical Analysis, 3719IT231A		Grade (10-100)	55	100%	84
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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Analyze, Design and Realize				
Requirements for participation in units of study (See also Article 29 TER)	None				
Compensation (See also Article 127 TER)	No				
Specific details	None				
Assessment objectives/criteria	▪ (1.2.1) Analyze problems for Errors, Approximations, Interpolations, Numerical Integration and Linear Equations ▪ (3.3.1) Solve problems for Errors, Approximations, Interpolations, Numerical Integration and Linear Equations ▪ (2.2.1) Make an Algorithm of the solution ▪ (1.3.1) Evaluate the result in comparison with the (unknown) solution				

Details of assessments	Written with test session	Written Exam
Strategies and teaching activities	Lectures, Labs	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

English 4 - 3719IT232Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Professionalization			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
English 4, 3719IT232A		Grade (10-100)	55	100%	84
Content of unit of study	We will begin by working on developing English vocabulary (formal vs informal) and by reviewing relevant points in grammar. In addition to focusing on reading, listening, and communicating, this course will include the element of intercultural communication, subsequently focusing on speaking (debate) and writing (a literature/book review and cultural dimensions according to Hofstede). The courses aim at for level B2 for written English (CEFR)				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	8.2.1 Communicate effectively with multiple stakeholders in an intercultural environment.				
Requirements for participation in units of	None				

study (See also Article 29 TER)		
Compensation (See also Article 127 TER)	No	
Specific details	Having completed ENG1 and ENG2 is preferred. Students are expected to have full knowledge of all aspects shared in these courses.	
Assessment objectives/criteria	▪ The Affirmative team support the statement ▪ The Negative team oppose the statement The debate is structured as follows: ▪ Claim - present your argument in a clear statement. This claim is one reason why you're in favor of/against the motion. ▪ Evidence - the evidence supporting your claim, such as, statistics, references, quotes, analogies etc. ▪ Impact - explain the significance of the evidence - how does this support your claim? Students will study Hofstede's theory on cultural dimensions and the theory of debate. They will conduct a literature review/book review in preparation of the debate. Students will carry out the debate in teams of 4.	
Details of assessments	Written with test session	Written without a formal test sitting. In class debate (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 debate which forms part of the final grade, followed by an individual exam (written assignment)	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Individual paper – written outside of class - aids and sources permitted. Debate: none	

ME learning challenge 2 - 3719IT233Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Professionalization			1
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
ME learning challenge 2, 3719IT233A		Grade (10-100)	55	100%	28
Content of unit of study	The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education is 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. 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 year 1, 2 and 3. 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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Management, Professionalization				
Requirements for participation in units of	None				

study (See also Article 29 TER)		
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ · Define learning objectives for a learning task. ▪ Select suitable educational resources. ▪ Create a work plan for a learning task. ▪ · Effectively develop professional competences at their study level by working according to a work plan. ▪ Collaborate effectively in a learning team. ▪ Communicate effectively with coaches and members of a learning team. ▪ Present the outcomes of a learning process. ▪ Reflect critically on the applied learning methods and learning process.	
Details of assessments	Other Method without test session	
Strategies and teaching activities	Group work	
Contact hours for strategies and teaching activities	32	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	All	

Graph Theory - 3719IT234Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Mathematics			3
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**	**Number of study hours**
Graph Theory, 3719IT234A		Grade (10-100)	55	100%	84

Content of unit of study	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 A to B? How vulnerable is a computer network to node failure? 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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analysis, Design
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None

Assessment objectives/criteria	▪ Recognize various mathematical proof techniques. ▪ Explain the steps of a given mathematical proof. ▪ Translate a real-world problem to a graph problem. ▪ Determine whether graph theoretical concepts apply to a given graph. ▪ Apply graph algorithms to a given graph. ▪ Make use of network analysis techniques to analyze a given graph. ▪ Interpret the results of network analysis techniques in the context of the original problem.	
Details of assessments	Written with test session	
Strategies and teaching activities	Instructions and exercises	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Object Oriented Programming 3 - 3719IT235Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Software Engineering			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Object Oriented Programming 3, 3719IT235A		Grade (10-100)	55	100%	84
Content of unit of study	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. 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. 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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
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. 3.3.2 - Build, test and deliver an app, application or information system that fits within the existing or desired environment.
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ Design an application in a way fitting with the purpose and environment of it (2.2.3)

	▪ Translate an information requirement to a technical design in an existing architecture (2.3.3) ▪ Use multithreading to implement a known but complex algorithm with a limited scope (3.2.1) ▪ Implement new functionality in a given architecture (3.3.2)	
Details of assessments	Written without test session	
Strategies and teaching activities	Class usually starts with an explanation of the subject for that day, supported by small code examples where useful. After this introduction, students practice using the exercises in the Exercise Manual, getting support and feedback from the teacher. At the start of the term an assignment is given on which students work during the course. They can ask for general feedback during the term. Students are also allowed to help each other, as long as they do not copy code, only concepts and ideas. The final result is handed in at the beginning of the first exam week and used to determine the final grade	
Contact hours for strategies and teaching activities	21	
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

Academic year	Term	Name of examination component			Study load in credits
2	Term 3	Research			2
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours

Research 2, 3713IT235A	Grade (10-100)	55	100%	56

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 quantitative research. Quantitative research methodologies are discussed and put into practice in a small-scale study.	
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation	
Learning outcomes	Analysis, Design, Implementation, Research	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Select an appropriate quantitative research methodology for a research problem. ▪ Independently conduct a small quantitative study. ▪ Determine the applicability of inferential statistics for a real-world problem. ▪ Select suitable statistical techniques to analyze quantitative research results. ▪ Perform inferential statistical analysis on quantitative research results. ▪ Reflect critically on research outcomes. ▪ Write a research report about a quantitative study.	
Details of assessments	Written without test session	The grade will be based on the quality of the research paper and the presentation.
Strategies and teaching activities	Instructions and working on assignment.	

Contact hours for strategies and teaching activities	17	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All	

Term 4

Project Web Science - 3719IT241Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 4	Mathematics			4
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Project Web Science, 3719IT241A		Grade (10-100)	55	100%	112
Content of unit of study	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. 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. 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 ULM, Software Development, and Object Oriented Programming. Finally, this course requires the skills developed in the Research courses.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analysis, Design, Implementation, Management, Advice, Research, Professionalization
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	▪ translate a real-world question into a web science problem. ▪ model (part of) a web site as a graph. ▪ select appropriate data structures for a web science problem. ▪ select appropriate graph algorithms for solving a web science problem. ▪ create an efficient implementation of graph theoretical concepts. ▪ analyze graphs that are too large to be visualized in full. ▪ evaluate the consequences of graph theoretical properties for real world graphs. ▪ work according to a project plan. ▪ perform managing tasks within a project group. ▪ communicate effectively and efficiently with all parties involved. ▪ divide work within a project team. ▪ write a well-structured report about a project. ▪ select and apply relevant, trustworthy, and recent sources to get a better understanding of the problem and theoretical background.

	▪ provide multiple solutions to encountered problems and make an informed choice for a solution. ▪ select a method for determining the effectiveness of a chosen solution. ▪ write and adapt a research proposal and/or research plan taking the interests of multiple stakeholders into account. ▪ analyze requirements and wishes in consultation with a client and describe the task, objectives, and scope of the assignment. ▪ formulate a relevant research question and subquestions for a research study. ▪ collaborate effectively in an intercultural (project) team in a setting with multiple stakeholders. ▪ direct and substantiate the development of personal professional competencies. ▪ apply knowledge, insights and skills and transfer these to others. ▪ demonstrate an appropriate professional attitude. ▪ communicate effectively with multiple stakeholders in an intercultural environment. ▪ contribute to a save and respectful work environment. ▪ operate in critical situations in an independent and stress-free manner. ▪ come up with creative solutions to problems.	
Details of assessments	Other Method without test session	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.	
Contact hours for strategies and teaching activities	32	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%. 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. 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.
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	All	

Cryptography - 3711IT423Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 4	Mathematics			3
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Cryptography, 3711IT423A		Grade (10-100)	55	100%	84
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.	
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation	
Learning outcomes	Analyze and Design	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ (1.1.1) understanding Cryptography by historical evolution ▪ (2.3.1) applying symmetric ciphers: block ciphers and stream ciphers (DES and AES) ▪ (2.3.1) applying asymmetric ciphers: RSA, DHKE, Elgamal Encryption ▪ (1.3.1) analyzing a problem for the right cipher ▪ (1.3.1) evaluating the security of the chosen cipher	
Details of assessments	Written with test session	Written Exam
Strategies and teaching activities	Lectures	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	

Permitted aids	None

Algorithms & Datastructures - 3719IT244Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 4	Mathematics			5
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Algorithms & Datastructures, 3719IT244A		Grade (10-100)	55	100%	140
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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Analysis, Design, Implementation				
Requirements for participation in units of study (See also Article 29 TER)	None				

Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	- Explain the role of algorithms and data structures in applications. - For the following data structures: linked lists, bags, queues, stacks, binary search trees, self-balancing trees, hashes - implement various representations of the data structures in memory; - manually execute the algorithms for manipulating these data structures; - compare the strong and weak points of the data structures. - For sorting algorithms, string processing algorithms, and compression algorithms - manually execute the algorithms; - compare the strong and weak points of the algorithms; - compute the worst-case computational complexity of the algorithms; - Construct regular expressions for string finding problems. - Convert between regular expressions and non-deterministic finite-state automata. - Set up experiments to test the average-case computational complexity of algorithms. - Implement algorithms and data structures. - Construct algorithms for real-world problems using appropriate existing algorithms and data structures.	
Details of assessments	Written with test session	
Strategies and teaching activities	Instructions and lab exercises	
Contact hours for strategies and teaching activities	31	

Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Management & Organization - 3719IT245Z

Academic year	Term	Name of examination component			Study load in credits
2	Term 4	Professionalization			2
Module name and code		Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Management & Organization, 3719IT245A		Grade (10-100)	55	100%	56
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.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	management, professionalization				
Requirements for participation in units of study (See also Article 29 TER)	n/a				
Compensation (See also Article 127 TER)	No				
Specific details	n/a				
Assessment objectives/criteria	after this module the student will be able to: 1. recognize and analyze much used theoretical models of organisational management; 2. recognize and discuss the steps of a strategy process for organizations.				

	3. recognize and discuss how efficient and affective the structure of the organization is for obtaining the specified goals; 4. recognize and discuss the culture of an organization based on well know theoretical models; 5. recognize and discuss theoretical models on leadership;	
Details of assessments	Written with test session	
Strategies and teaching activities	instructions and excersizes	
Contact hours for strategies and teaching activities	27	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	none	

Year 3

Term 3/4

ME learning challenge 3 - 3718IT331Z

Academic year	Term	Name of examination component		With graduation product	Graduation product designation	Study load in credits
3	Term 3	Professionalization		No	No	1
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**		**Number of study hours**
ME learning challenge 3, 3718IT331A		Grade (10-100)	55	100%		28
Content of unit of study	The field of Mathematical Engineering is constantly in motion. Every day new techniques and tools are being developed. As a result, education is 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. 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 year 1, 2 and 3. 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.					

Phase of Bachelor's programme	In possession of the skills necessary for professionalisation	
Learning outcomes	Management, Professionalization	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Define learning objectives for a learning task. ▪ Select suitable educational resources. ▪ Create a work plan for a learning task. ▪ · Effectively develop professional competences at their study level by working according to a work plan. ▪ Collaborate effectively in a learning team. ▪ Communicate effectively with coaches and members of a learning team. ▪ Present the outcomes of a learning process. ▪ Reflect critically on the applied learning methods and learning process.	
Details of assessments	Other Method without test session	
Strategies and teaching activities	Group work	
Contact hours for strategies and teaching activities	32	
Compulsory attendance (See also Article 115 TER)	Yes	
Permitted aids	All	

Minor Mobile Development

Academic year	Term		With graduation product	Graduation product designation	Study load in credits
3	Term 3		No	No	15
Module name and code	**Assessment scale**	**Required minimum score**	**Weighting Factor**		**Number of study hours**
Mobile Development	Grade (10-100)	55	100%		420
Content of unit of study	The role of mobile computing devices in modern society can hardly be underestimated. In the Netherlands, about 30 percent of the families has one or more tablets. About sixty percent of the Dutch owns and uses a smartphone. This means the role of computing is changing drastically; information technology has become something you have in your pocket and use for things undreamt of twenty years ago. For professionals in Mathematical Engineering or Information Technology this means they have to have some skills in developing applications for these mobile devices. The kind of applications will differ widely, but the basics are the same. During this course, students will learn how to write applications for the Android platform. At the end, they will have written a full-fledged application which uses the hardware available.				
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation				
Learning outcomes	Analyze, Design, Realize and Research				
Requirements for participation in units of study (See also Article 29 TER)	Successfully finished the internship in year 3.				
Compensation (See also Article 127 TER)	No				
Specific details	None				
Assessment objectives/criteria	After successfully completing this module, the student is able to:				

	▪ Research the market and come up with an idea for a new mobile application ▪ Take an idea for a mobile application and translate this into a high-level design ▪ Develop the architecture of an Android application ▪ Implement the mobile application using a variety of tools ▪ Search and find resources to improve the application beyond the already known	
Details of assessments	Written without test session	This module will be examined by a practical exam. During the first term of the course, each student designs an Android application at a very high level (wireframes etc.) and implements a list of basic features to demonstrate Android development techniques. During the second term of the course, the student works on advanced features such as Web connectivity, higher level APIs such as Google Map and Play and Hardware and Sensors. The idea, design and implementation is evaluated by the teacher in the assessments. The deadline for the assessment is the Friday of the second exam week during which the course was taught. The deadline for the resit is the Friday of the second exam week of the exam period after this. Handing in after the deadline is an automatic fail of the assignment, with no feedback given.
Strategies and teaching activities	Classes will be a mix of presentations on the subjects of that day and progress meeting on functionality developed by the student. The teacher will give short demonstrations of demo application and features, to explore the possibilities of the technology, so this part of the lesson will have little preparation from the teacher. When this explorative phase is finished, students will work on assignments given, finishing them between classes. During the first few lectures, students have to come up with an idea for a mobile application they would like to build themselves. They set up the	

	rough idea by drawing some wireframes and describing the functionality envisioned in a few paragraphs. The final idea has to be approved by the teacher. The final result is a mobile app using the hardware of the mobile device.	
Contact hours for strategies and teaching activities		
Compulsory attendance (See also Article 115 TER)	No	No
Permitted aids	N/A	

Open minor

Follow this link for other minors: Kies op maat Modules

Year 4

Term 1

Data Mining & Analysis - 3711IT411Z

Academic year	Term	Name of examination component		With graduation product	Graduation product designation	Study load in credits
4	Term 1	Data		No	No	4
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**		**Number of study hours**
Data Mining & Analysis, 3711IT411A		Grade (10-100)	55	100%		112
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. 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. 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. 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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analysis, Design, Implementation
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully completing this module, the student is able to:

	▪ explain the goals of data mining; ▪ explain the different data mining tasks; ▪ explain the main five steps of the data mining process; ▪ convert a real-world problem into a data analysis or mining task; ▪ choose an appropriate data mining method for a real-world problem; ▪ independently explore a data set; ▪ by means of statistical or data mining software preprocess a real-world data set to prepare it for data analysis and mining; ▪ explain the working, advantages, and disadvantages of a number of prediction, classification, and clustering algorithms; ▪ manually apply a number of prediction, classification, and clustering algorithms to a small example data set; ▪ apply a number of prediction, classification, and clustering algorithms to a realistic data set by means of data mining software; ▪ set-up and conduct a data mining experiment; ▪ interpret the results of a data mining experiment; ▪ identify common difficulties in data mining projects.	
Details of assessments	Written with test session	The exam consists of open questions.
Strategies and teaching activities	Instructions and lab sessions.	
Contact hours for strategies and teaching activities	31	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	Calculator	

Advanced Data Disclosure - 3712IT411Z

Academic year	Term	Name of examination component	With graduation product	Graduation product designation	Study load in credits
4	Term 1	Data	No	No	5

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Advanced Data Disclosure, 3712IT411A	Grade (10-100)	55	100%	140

Content of unit of study	Relational databases form an effective solution for storing and retrieving structured data. However, a large part of the data that is nowadays available is not structured, but comes in the form of text (unstructured data) or XML-documents (semi-structured data). For these types of data different solutions are necessary. The first part of this course treats so called NoSQL databases. These advanced databases can be used to disclose semi-structured data. The second part of the course focusses on text processing and information retrieval (IR) as a means for retrieving text documents. The course builds upon the databases courses and the courses on algorithms and data structures.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analyze, Design
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	▪ After successfully completing this module, the student is able to: ▪ choose a suitable data storage and retrieval method for a real-world problem; ▪ explain the various ways to distribute databases;

	▪ write queries for NoSQL databases; ▪ explain the working of various components of a natural language processing system; ▪ select suitable text preprocessing and mining algorithms for a textual data set; ▪ apply algorithms for text preprocessing and mining to small scale problems; ▪ ▪ apply algorithms for text retrieval to small-scale problems.	
Details of assessments	Written with test session	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	
Contact hours for strategies and teaching activities	24	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	None	

Research 4 - 3711IT422Z

Academic year	Term	Name of examination component		With graduation product	Graduation product designation	Study load in credits
4	Term 1	Research		No	No	2
Module name and code		Assessment scale	Required minimum score	Weighting Factor		Number of study hours
Research 4, 3711IT422A		Grade (10-100)	55	100%		56
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.	
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation	
Learning outcomes	Research, Advice	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Find high quality literature on a research topic. ▪ Assess the quality of literature. ▪ Recognize various types of literature review. ▪ Set-up and conduct a literature review. ▪ Reflect critically on a literature review. ▪ Write a paper about a literature review.	
Details of assessments	Written without test session	The grade will be based on the quality of the research paper and presentation.
Strategies and teaching activities	Instructions and working on assignment.	
Contact hours for strategies and teaching activities	15	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All	

Term 2

Project Big Data - 3711IT421Z

Academic year	Term	Name of examination component		With graduation product	Graduation product designation	Study load in credits
4	Term 2	Data		No	No	5
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**		**Number of study hours**
Project Big Data, 3711IT421A		Grade (10-100)	55	100%		140
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.					
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation					
Learning outcomes	Analysis, Design, Implementation, Control, Management, Advice, Research, Professionalization					
Requirements for participation in units of study (See also Article 29 TER)	None					
Compensation (See also Article 127 TER)	No					
Specific details	None					
Assessment objectives/criteria	▪ model a real-world problem as a big data task. ▪ perform exploratory data analysis on a real-world data set.					

	▪ select a suitable data storage and analysis environment for a data science project. ▪ select relevant data preprocessing techniques. ▪ select relevant data mining techniques. ▪ manage and store large amounts of data in a such a way that it becomes ready for analysis. ▪ preprocess and integrate data from multiple sources. ▪ apply data preprocessing techniques using data mining software. ▪ apply and evaluate data mining techniques using data mining software. ▪ make recommendations for optimization of a product, service, or process based on results of data analysis. ▪ list and select project methods and software development methods. ▪ create, track and update a project plan. ▪ perform simple supervisory and/or management tasks (within a project group) and prepare for contingencies. ▪ consult effectively and efficiently with those involved. ▪ allocate and delegate tasks within a project. ▪ create a recommendation based on substantiated arguments. ▪ communicate effectively, both orally and in writing, with people of various ranks. ▪ create an advisory report according to the guidelines. ▪ 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. ▪ provide multiple solutions to encountered problems, make an informed choice for a solution, and formulate recommendations for future (research) steps. ▪ determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives. ▪ reflect critically on the planned approach and actual implementation of a study.

	▪ make a theoretically substantiated choice for research methods to answer the research questions. ▪ reflect critically on the choices made in a study and describe the consequences of those choices . ▪ collaborate effectively in an intercultural project team in a multidisciplinary environment. ▪ direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other thing. ▪ demonstrate an appropriate professional attitude taking relevant ethical aspects into account. ▪ communicate effectively in a multidisciplinary, international, and intercultural environment. ▪ contribute to the creation of a save and respectful work environment. ▪ perform management tasks within a project team.	
Details of assessments	Other Method without test session	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.	
Contact hours for strategies and teaching activities	32	
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 80%.

		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. 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	

Business Intelligence - 3715IT422Z

Academic year	Term	Name of examination component		With graduation product	Graduation product designation	Study load in credits
4	Term 2	Data		No	No	2
Module name and code		**Assessment scale**	**Required minimum score**	**Weighting Factor**		**Number of study hours**
Business Intelligence, 3715IT422A		Grade (10-100)	55	100%		56
Content of unit of study	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. 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.					
Phase of Bachelor's programme	Level of competency required by a professional at the start of his career					

Learning outcomes	Analyze, design and research	
Requirements for participation in units of study (See also Article 29 TER)	None	
Compensation (See also Article 127 TER)	No	
Specific details	None	
Assessment objectives/criteria	▪ Fundamental Concepts of BI ▪ Data quality and visualisation ▪ Data warehouse architecture ▪ Relational & Multidimensional design ▪ ETL techniques ▪ Data visualisation	
Details of assessments	Written without test session	
Strategies and teaching activities	Class will be theorical. Students learn the ideas behind important BI and BI related concepts.	
Contact hours for strategies and teaching activities	24	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All available relevant sources	

Emerging Technologies - 3715IT424Z

Academic year	Term	Name of examination component	With graduation product	Graduation product designation	Study load in credits
4	Term 2	Professionalization	No	No	5

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Emerging Technologies, 3715IT424A	Grade (10-100)	55	100%	140

Content of unit of study

Information Technology and Computer Sciences are strongly developing fields, where new technologies scan 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:

- Personal computers ("There is no reason anyone would want a computer in their home." Ken Olsen, founder of Digital Equipment Corporation, 1977)
- 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)

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.
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.

Because of the nature of this course, details about content and assessment will be published shortly before the start of the course.

Phase of Bachelor's programme	Level of competency required by a professional at the start of his career
Learning outcomes	After successfully completing this module, the student is able to: ▪ Collect and understand relevant information on new technologies (8.3.2) ▪ Develop and express a substantiated opinion on the viability of the new technology (7.3.3) ▪ Analyze the technology to understand the architecture and implementation (3.3.2) ▪ Implement the technology in an existing infrastructure (2.3.3) ▪ Adapt or add to the technology to make it fit for purpose (3.3.1)
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)
Compensation (See also Article 127 TER)	No
Specific details	None

Assessment objectives/criteria	2.3.3 - Design an app, application or information system suited to the existing or desired environment. 3.3.1 - Implement the application of a designed algorithm or mathematical model. 3.3.2 - Build, test and deliver an app, application or information system that fits within the existing or desired environment. 7.3.3 - Determine the expected effectiveness of possible solutions and provide insights in the effects of the various alternatives. 8.3.2 - Direct and substantiate the development of personal professional competencies on the basis of feedback and self-reflection, among other things.	
Details of assessments	Written without	The assessment consists of two parts:

	test session	▪ A paper on the chosen technology stack (60%) ▪ A practical assignment where the student has to adapt a (demonstration model of) the chosen technology to achieve a specified purpose (40%)
Strategies and teaching activities	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 networks and using them. Another activity is to analyze 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.	
Contact hours for strategies and teaching activities	21	
Compulsory attendance (See also Article 115 TER)	No	
Permitted aids	All	

Distributed Systems and Parallel Computing - 3712IT412Z

Academic year	Term	Name of examination component	With graduation product	Graduation product designation	Study load in credits
4	Term 2	Data	No	No	3

Module name and code	Assessment scale	Required minimum score	Weighting Factor	Number of study hours
Distributed Systems and Parallel Computing, 3712IT412A	Grade (10-100)	55	100%	84

Content of unit of study	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. 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.
Phase of Bachelor's programme	In possession of the skills necessary for professionalisation
Learning outcomes	Analyse, Design, Implementation
Requirements for participation in units of study (See also Article 29 TER)	None
Compensation (See also Article 127 TER)	No
Specific details	None
Assessment objectives/criteria	After successfully completing this module, the student is able to: ▪ explain the various ways to distribute computation; ▪ set up a small scale cluster; ▪ estimate the performance gains of parallelizing a computation task; ▪ effectively parallelize an algorithm within the Spark framework; ▪ implement a parallel algorithm using Spark; ▪ run a job in a distributed environment.

Details of assessments	Written without test session	Portfolio that documents case studies on parallel computing they worked on
Strategies and teaching activities	Lectures and lab sessions	
Contact hours for strategies and teaching activities	30	
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		