Kooperationsprojekt NAWI Graz

Curriculum for the master's degree programme in

Mathematics

Curriculum 2015 in the version 2015

This curriculum was approved by the Senate of the University of Graz in the meeting dated 11.03.2015 and by the Senate of Graz University of Technology in the meeting dated 02.03.2015.[1]

The study programme is organised as a combined study programme (§ 54 para. 9 UG) of the University of Graz (Uni Graz) and Graz University of Technology (TU Graz) in the context of "NAWI Graz". This study programme is legally based on the Universities Act of 2002 (UG) and on the provisions of the Statutes of Uni Graz and TU Graz as amended.

(Please note: The English version of this document is a courtesy translation. Only the German version is legally binding.)

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[1] The date of approval refers to the German version of this curriculum.

§ 1 General provisions

The engineering sciences master's degree programme in Mathematics comprises four semesters. The total scope of the programme is 120 ECTS credit points according to § 51 para. 2 subpara. 26 UG.

The master's degree programme in Mathematics is held in English according to § 64 para. 6 UG.

Graduates of this programme are awarded the university degree of "Diplom-Ingenieurin"/"Diplom-Ingenieur", abbreviated: "Dipl.-Ing." or "DI". The international equivalent of this university degree is "Master of Science", abbreviated: "MSc".

§ 2 Object of study programme and qualification profile

(1) Object of study programme
The master's degree programme in Mathematics builds upon the content of a subject-related bachelor's degree programme and provides a sound further education in the basics of the mathematical fields that are of particular significance for a career as a mathematician in industry, business and science. In addition, students have the possibility to specialise in a specific area through the choice of a suitable focus area.

(2) Qualification profile and competencies
This degree is awarded to students who have demonstrated the following competencies through individual examinations, a master's examination before a committee and a master's thesis:

Graduates of this study programme

- have broadened and deepened the basic mathematical competencies building on those obtained at bachelor's level;
- are familiar with mathematical theories at a higher level of abstraction;
- are able to develop mathematical subareas independently;
- have been trained in mathematical ways of thinking and working, particularly
    - in recognising structures and relationships;
    - in abstractional and analytical abilities;
    - in deductive approaches, and

  - in formal and algorithmic thinking;
- have further developed their problem-solving abilities, such as
  - in the mathematical modelling of processes in technology, business and natural sciences;
  - in the appropriate use of computer-aided tools, and
  - in the critical interpretation of results;
- are able to apply their expertise in their workplace, to communicate the results of their work to others and to participate flexibly in the latest developments through sound basic knowledge with reference to application;
- have acquired learning strategies that enable them to continue their studies independently;
- have acquired the following social competencies, among others, during their study programme:
  - the ability to work in a team;
  - discussion and communication skills, including with those unfamiliar with the subject;
  - the ability to give presentations to audiences that are familiar or unfamiliar with the subject, and
  - leadership skills.

After successfully completing the master's degree programme in Mathematics, graduates have an in-depth knowledge of
- analysis;
- algebra;
- stochastics;
- numerical mathematics, and
- discrete mathematics.

Depending on the focus area they choose, they also have an in-depth knowledge of the theory and numerics of partial differential equations, financial and actuarial mathematics, algebra and discrete mathematics, continuous and discrete optimisation, statistics, or applications of mathematics in engineering.

(3) Demand for and relevance of the study programme for science and on the job market

Graduates of this study programme are capable of abstract and interdisciplinary thinking as a result of their mathematical education. This and their knowledge of how mathematical methods can be applied make them widely employable in industry, business and science. Examples of possible areas of activity are
- modelling and simulation in industry and business;
- the development, analysis and implementation of simulation tools;
- the optimisation of processes in industry and business;
- the collection and analysis of statistical data;
- data technology, data security and cryptography;
- the structuring, modelling, valuation and risk assessment of financial products in the banking and insurance industries, and

- specialisation in a subject as part of a doctoral degree programme.

§ 3 Admission requirements

(1) Admission to a master's degree programme requires a subject-related bachelor's degree of a university or Fachhochschule (university of applied sciences) or another equivalent degree of a recognised Austrian or foreign post-secondary educational institution (§ 64 para. 5 UG).

(2) The master's degree programme in Mathematics is based on the bachelor's degree programme in Mathematics offered by NAWI Graz. Graduates of the bachelor's study programme fulfil the admission requirements for the master's degree programme in Mathematics.

(3) In order to obtain an overall scope of 300 ECTS credit points for the postgraduate study programmes, assigning the same course in the master's degree programme and the bachelor's degree programme which grants admission to the master's degree programme shall be excluded.

§ 4 Structure and organisation of the study programme

(1) The master's degree programme in Mathematics with a workload of 120 ECTS credit points comprises four semesters. In total, there are 89 ECTS credit points assigned to the courses, 6 of which are assigned to the free-choice subject. 30 ECTS credit points are awarded for the master's thesis and 1 ECTS credit point is awarded for the master's degree examination.

Modules/subjects	**ECTS**
Module A: Advanced Analysis	6
Module B: Discrete and Algebraic Structures	6
Module Focus area Applied Mathematics *or*	55
Module Focus area Discrete Mathematics *or*	
Module Focus area Financial and Actuarial Mathematics *or*	
Module Focus area Statistics and Operations Research *or*	
Module Focus area Technomathematics	
Elective subject Mathematics	12
Module Seminar	4
Free-choice subject	6
Master's thesis	30
Master's degree examination	1
Total	**120**

One of the five focus areas listed above must be chosen as a whole.

(2) All achievements to be obtained by the students are assigned ECTS credit points. These ECTS credit points are used to determine the relative weight of the workload of the individual academic achievements; the workload of one year must comprise 1500 hours and 60 ECTS credit points are awarded for this workload. The workload comprises the self-study part and the semester hours. One semester hour corresponds to 45 minutes per study week of the semester.

§ 5 Types of courses

(1) **Lectures (VO)*:** Lectures serve as an introduction to the methods of the subject and for the teaching of an overview and specialised knowledge of accepted scientific findings in the field, the current state of research and the specific research areas of the subject.

(2) **Lectures with integrated exercises (VU)*:** Comprise the teaching of an overview, specialised knowledge and practical skills. These are courses with continual assessment.

(3) **Exercises (UE)*:** Exercises must correspond to the practical aims of the study programmes and are designed to solve specific tasks. These are courses with continual assessment.

(4) **Seminars (SE)*:** Seminars are designed as independent scientific work and scientific discussion of this work, for which a topic must be elaborated in writing and presented orally. A discussion on this topic must be held. These are courses with continual assessment.

(5) **Projects (PR)*:** In projects, experimental, theoretical and/or design applied work is carried out, or small research papers are written, taking into account all necessary steps. Projects are completed with a written paper that is part of the assessment.

*The types of courses stated in the Statute (Uni Graz) or Guidelines (TU Graz) of the two universities shall apply. See § 1 para. 3 of the Statute of Uni Graz or the Guidelines for the types of courses of the Curricula Commission of the Senate of TU Graz dated 06.10.2008 (published in the University Gazette of TU Graz dated 03.12.2008).

The maximum numbers of participants (group sizes) are as follows:

Lecture (VO) Lecture component of lecture with integrated exercises (VU)	No restriction
Exercise (UE) Exercise component of VU	25
Seminar (SE)	10
Project (PR)	5

§ 6 Guidelines for the allocation of places on courses

(1) If the number of students registered for a course exceeds the number of available places, parallel courses are to be provided. If necessary, these parallel courses may also be provided during the semester break.

(2) If it is not possible to offer a sufficient number of parallel courses (groups), the students are to be admitted to the course according to the following priority ranking:

a. Students who are required to complete the course according to their curriculum.
b. The sum of the successfully completed courses of the respective study programme (total ECTS credit points)
c. The date (early date has priority) of the fulfilment of the participation requirement
d. Students who have already been placed on a waiting list or who have to repeat the course are to be given priority on the next course.
e. The further ranking is made according to the grade of the examination or the average grade of the examinations (weighted on the basis of the ECTS credit points) of the respective course(s) that are specified as the participation requirement.
f. Students who do not need to complete such courses in order to fulfil their curriculum are only considered based on the number of free places. It is possible to be included on a separate waiting list. The above-mentioned provisions shall apply accordingly.

(3) Students who complete a part of their studies at the universities participating in NAWI Graz in the context of mobility programmes are given priority for up to 10% of the available places.

§ 7 Course content and curriculum

The individual courses of this master's degree programme and their allocation to the examination subjects (modules or elective subjects) are indicated hereinafter. The knowledge, methods or skills to be provided in the modules are described in more detail in Annex II. The semester allocation is a recommendation and ensures that the sequence of courses builds optimally on previous knowledge and that the workload of an academic year does not exceed 60 ECTS credit points. Annex I contains the allocation of the courses to the participating universities.

Master's degree programme in Mathematics

Module	Course	SSt	Type of course	ECTS	Semester incl. ECTS I	II	III	IV
Module A Advanced analysis (compulsory subject)								
	Advanced analysis	3	VO	4.5	4.5			
	Advanced analysis	1	UE	1.5	1.5			
Module B Discrete and algebraic structures (compulsory subject)								
	Discrete and algebraic structures	3	VO	4.5	4.5			
	Discrete and algebraic structures	1	UE	1.5	1.5			
Module Seminar (compulsory subject)								
	Seminar	2	SE	4			4	
	Total	**10**		**16**	**12**		**4**	
Module Focus area Applied Mathematics								
	Advanced functional analysis	3	VO	4.5	4.5			
	Advanced functional analysis	1	UE	1.5	1.5			
	Non-linear optimisation	4	VO	6	6			
	Non-linear optimisation	2	UE	3	3			
	High-performance computing	2[1]	VU	2.5	2.5			
	Partial differential equations and dynamical systems	4	VO	6		6		
	Partial differential equations and dynamical systems	2	UE	3		3		
	Numerics of partial differential equations	4	VO	6		6		
	Numerics of partial differential equations	2	UE	3		3		
	Mathematical modelling in the natural sciences	3	VO	4		4		
	Mathematical modelling in the natural sciences	1	UE	1		1		
	Scientific computing in mathematics	2[1]	VU	2.5		2.5		
	Inverse problems	3	VO	4.5			4.5	
	Inverse problems	1	UE	1.5			1.5	
	Stochastic models	3	VO	4.5			4.5	
	Stochastic models	1	UE	1.5			1.5	
	Total for Focus area Applied Mathematics			**55**	**18**	**25**	**12**	
Module Focus area Discrete Mathematics								
	Advanced probability	3	VO	4.5	4.5			
	Advanced probability	1	UE	1.5	1.5			
	Number theory	3	VO	4.5	4.5			
	Number theory	1	UE	1.5	1.5			
	Discrete and computational geometry	3	VO	4.5	4.5			
	Discrete and computational geometry	1	UE	1.5	1.5			
	Mathematical foundations of information theory	3	VO	4.5		4.5		

Master's degree programme in Mathematics								
Module	**Course**		**Type of**		**Semester incl. ECTS**			
		SSt	**course**	**ECTS**	**I**	**II**	**III**	**IV**
	Mathematical foundations of information theory	1	UE	1		1		
	Commutative algebra	3	VO	4.5		4.5		
	Commutative algebra	1	UE	1.5		1.5		
	Advanced and algorithmic graph theory	3	VO	4.5		4.5		
	Advanced and algorithmic graph theory	1	UE	1.5		1.5		
	Analytic combinatorics	3^2	VU	4.5		4.5		
	Algebraic curves and cryptography	3^2	VU	4.5			4.5	
	Probabilistic method in combinatorics and algorithmics	3^2	VU	4.5			4.5	
	Specialisation *(choose a VO and UE with the same title):*			6				
	Combinatorial optimisation 2	3	VO	4.5		4.5		
	Combinatorial optimisation 2	1	UE	1.5		1.5		
	Noncommutative algebra	3	VO	4.5			4.5	
	Noncommutative algebra	1	UE	1.5			1.5	
	Complexity theory	3	VO	4.5			4.5	
	Complexity theory	1	UE	1.5			1.5	
	Total for Focus area Discrete Mathematics			**55**	**18**	**22/ 28**	**15/ 9**	
Module Focus area Financial and Actuarial Mathematics								
	Advanced probability	3	VO	4.5	4.5			
	Advanced probability	1	UE	1.5	1.5			
	Mathematical statistics	3	VO	4.5	4.5			
	Mathematical statistics	1	UE	1.5	1.5			
	Versicherungsvertragsrecht[3]	2	VO	3	3			
	Stochastic analysis	3	VO	4.5		4.5		
	Stochastic analysis	1	UE	1.5		1.5		
	Advanced actuarial mathematics	2	VO	3		3		
	Advanced actuarial mathematics	1	UE	1		1		
	Non-life insurance mathematics	2	VO	3		3		
	Non-life insurance mathematics	1	UE	1		1		
	Versicherungswirtschaftslehre[3]	2	VO	3		3		
	Advanced financial mathematics	3	VO	4.5			4.5	
	Advanced financial mathematics	1	UE	1.5			1.5	
	Risk theory and management in actuarial science	3	VO	4.5			4.5	
	Risk theory and management in actuarial science	1	UE	1.5			1.5	
	Project in finance and insurance	2	PR	5			5	
	Actuarial specialisation *(choose two out of four courses):*			6				
	Life and health insurance mathematics	2	VO	3			3	
	Actuarial modelling	2	VO	3			3	
	Statistical methods in actuarial science	2	VO	3				
	Financial management	2	VO	3				

Master's degree programme in Mathematics								
Module	**Course**	**SSt**	**Type of course**	**ECTS**	**Semester incl. ECTS I**	**II**	**III**	**IV**
	Total for Focus area Financial and Actuarial Mathematics			**55**	**15**	**20**	**20**	
Module Focus area Statistics and Operations Research								
	Advanced probability	3	VO	4.5	4.5			
	Advanced probability	1	UE	1.5	1.5			
	Mathematical statistics	3	VO	4.5	4.5			
	Mathematical statistics	1	UE	1.5	1.5			
	Operations Research	3	VO	4.5	4.5			
	Operations Research	1	UE	1.5	1.5			
	Regression analysis	3	VO	4		4		
	Regression analysis	1	UE	1.5		1.5		
	Combinatorial optimisation 2	3	VO	4.5		4.5		
	Combinatorial optimisation 2	1	UE	1.5		1.5		
	Project in Statistics and Operations Research	2	PR	4.5			4.5	
	Non-linear optimisation	4	VO	6			6	
	Non-linear optimisation	2	UE	3			3	
	Applied statistics	3	VO	4.5			4.5	
	Applied statistics	1	UE	1.5			1.5	
	Specialisation *(choose a VO and UE with the same title):*			6				
	Time series analysis	3	VO	4.5		4.5		
	Time series analysis	1	UE	1.5		1.5		
	Advanced and algorithmic graph theory	3	VO	4.5		4.5		
	Advanced and algorithmic graph theory	1	UE	1.5		1.5		
	Generalised linear models	3	VO	4.5			4.5	
	Generalised linear models	1	UE	1.5			1.5	
	Complexity theory	3	VO	4.5			4.5	
	Complexity theory	1	UE	1.5			1.5	
	Total for Focus area Statistics and Operations Research			**55**	**18**	**11.5/ 17.5**	**25.5/ 19.5**	
Module Focus area Technomathematics								
	Advanced functional analysis	3	VO	4.5	4.5			
	Advanced functional analysis	1	UE	1.5	1.5			
	Numerical mathematics 4	3	VO	4	4			
	Numerical mathematics 4	1	UE	1.5	1.5			
	Partial differential equations and boundary value problems	3	VO	4.5		4.5		
	Partial differential equations and boundary value problems	1	UE	1.5		1.5		
	Numerics and simulation	3	VO	4		4		
	Numerics and simulation	1	UE	1.5		1.5		
	Calculus of variations	2	VO	3		3		
	Calculus of variations	1	UE	1		1		
	Mathematical modelling in engineering	4	VO	6			6	
	Inverse Problems	3	VO	4.5			4.5	
	Inverse Problems	1	UE	1.5			1.5	

Master's degree programme in Mathematics								
Module	**Course**		**Type of**		**Semester incl. ECTS**			
		SSt	**course**	**ECTS**	**I**	**II**	**III**	**IV**
	Project Technomathematics	2	PR	4			4	
	Specialisation *(12 ECTS have to be chosen from the following list):*			12				
	Strömungslehre & Wärmeübertragung I[3]	4	VO	6		6		
	Strömungslehre & Wärmeübertragung I[3]	2	UE	3		3		
	Introduction to biomechanics	3[2]	VU	4		4		
	Quantenmechanik[3]	4	VO	6.5		6.5		
	Introduction to Theoretical Physics	3	VO	4.5		4.5		
	Continuum mechanics	3[2]	VU	4.5			4.5	
	Numerische Methoden Strömungslehre und Wärmeübertragung[3]	3	VO	4.5			4.5	
	Mehrkörperdynamik[3]	3	VO	4.5			4.5	
	Mehrkörperdynamik[3]	1	UE	1			1	
	Elastizitätstheorie I[3]	2[1]	VU	3			3	
	Biomechanics of biological tissues	2	VO	3			3	
	Theoretical solid-state physics	2	VO	3			3	
	Total for Focus area Technomathematics			**55**	**11.5**	**21.5**	**22**	

Total modules (compulsory subjects)	71	
Elective subject Mathematics	12	
Total elective subjects according to § 8 below	12	
Master's thesis	30	30
Master's degree examination	1	1

Free-choice subject according to § 9 below	6					
Overall totals	**120**	**30**	**30**	**29**	**31**

[1] 1 SSt lecture component, 1 SSt exercise component

[2] 2 SSt lecture component, 1 SSt exercise component

[3] These courses are generally offered in German.

Abbreviations: PR: project; SE: seminar; SSt: semester hours/contact hours; UE: exercise; VO: lecture; VU: lecture with integrated exercises

It is recommended that students individually allocate the free-choice subjects and elective subjects to the semesters so that 30 ECTS credit points are completed per semester.

It is recommended that students complete a semester abroad in their 3rd or 4th semester.

The courses *Versicherungsvertragsrecht* (insurance contract law) and *Versicherungswirtschaftlehre* (insurance economics) contain specific Austrian legal provisions that serve as a basis for a further education to become an Austrian actuary, and are therefore offered exclusively in German. These courses can be replaced by further courses from the *Actuarial specialisation*.

§ 8 Catalogue of electives

As described below, courses with a total scope of 12 ECTS credit points must be completed:

(1) All courses of the focus areas can be chosen except courses of the selected one.

(2) Courses with the title "Elective subject Mathematics (subtitle)" are assigned to the elective subject Mathematics, whereby a semester hour generally corresponds to 1.5 ECTS credit points. These courses are offered with descriptive subtitles with a total scope of 1-3 SSt for lectures and/or 1-2 SSt for exercises. Courses with different subtitles shall be classified as different courses.

(3) Courses can be completed to improve knowledge of a foreign language (English or German) with a total scope of up to 3 ECTS credit points.

§ 9 Free-choice subject

(1) The courses to be completed as part of the free-choice subject for the master's degree programme in Mathematics are designed to provide individual emphasis and further development of the students. They can be freely selected from the courses offered by any recognised Austrian or foreign university, as well as Austrian universities of applied sciences and university colleges for education. Annex III contains a recommendation of eligible courses and subjects.

(2) If no ECTS credit points are assigned to a free-choice course, one ECTS credit point is awarded for every semester hour (SSt) of this course. If such courses are lecture-type courses (VO), they are assigned 1.5 ECTS credit points for each semester hour.

(3) There is also the possibility of completing a vocational (subject-relevant) internship as part of the free-choice subject for a maximum of 4 weeks as full-time employment (this corresponds to 6 ECTS credit points). This internship shall be approved by the officer responsible for study matters and should be a meaningful addition to the study programme. Completion of the vocational (subject-relevant) internship shall be verified by the employer with whom the internship was carried out.

§ 10 Admission requirements for courses/examinations

(1) Admission to the master's examination before a committee requires proof of the positive assessment of all examination results according to § 4 above and the positive assessment of the master's thesis.

(2) With the exception of the master's examination before a committee, admission to examinations is not subject to any prerequisites.

§ 11 Master's thesis

(1) The master's thesis is proof of the student's capability to perform scientific research and development tasks independently and with academic grounding as far as content and methodology are concerned. The scope of work of the master's thesis must enable students to finish their thesis within a period of six months.

(2) The topic for the master's thesis shall be taken from one of the focus areas. The officer responsible for study matters shall decide on exceptions. Before a student starts work on their master's thesis, it must be registered via the responsible dean's office with the involvement of the officer responsible for study matters. The topic, the area of expertise of the topic and the supervisor as well as the institute must be stated.

(3) 30 ECTS credit points are awarded for the master's thesis.

(4) The master's thesis is to be submitted for evaluation in printed and in electronic form.

§ 12 Examination regulations

(1) Courses are evaluated individually.
   a. Examinations for courses held as lectures (VO) shall cover the complete content of the course. The examinations are in writing or orally, or orally and in writing.
   b. For courses held as lectures with integrated exercises (VU), exercises (UE), projects (PR) and seminars (SE), a student's performance is continually assessed on the basis of that student's contributions and/or through accompanying tests. The assessment must always consist of at least two examinations.

(2) Examinations with positive results are to be assessed as "very good" (1), "good" (2), "satisfactory" (3) or "sufficient" (4); those with negative results are to be assessed as "insufficient" (5). If this type of assessment is not possible or inappropriate, the positive assessment must be assessed as "successful participation" and the negative assessment must be assessed as "unsuccessful participation".

(3) If an examination subject (module or elective subject) includes separate examinations for the relevant courses, the overall subject grade is to be determined by:

   a. multiplying the grade of each examination result in connection with the subject with the ECTS credit points of the corresponding course;

b. adding the values calculated according to lit. a);
c. dividing the result of the addition by the sum of the ECTS credit points of the courses, and
d. rounding the result of the division to a whole-numbered grade if required. The grade must be rounded up if the decimal place exceeds 0.5. Otherwise, the grade must be rounded down.
e. A positive subject grade can only be awarded if every individual examination result is positively assessed.
f. Courses which are exclusively assessed by successful/unsuccessful participation shall not be included in this calculation according to lit. a to d.

(4) The master's examination before a committee consists of:

- the presentation of the master's thesis (maximum duration: 20 minutes),
- an examination about an area of expertise to which the master's thesis is assigned (maximum duration: 20 minutes), and
- an examination about a further subject according to § 7 above (maximum duration: 20 minutes).

The examination subjects are determined on the basis of candidate's suggestion by the officer responsible for study matters at the university to which the candidate is admitted. When choosing the examination subjects, attention shall be paid to sufficient breadth of subjects.

(5) The master's examination senate consists of the supervisor of the master's thesis and two further members nominated by the officer responsible for study matters after hearing the candidate's suggestion. The senate is chaired by a member of the examination senate who is not the supervisor of the master's thesis.

(6) The overall grade of this examination before a committee is determined by the examination senate considering all parts of the examination.

§ 13 Diploma

(1) The study programme is completed by passing a master's thesis and a master's examination before a committee according to § 12 para. 4 above.

(2) A diploma certificate shall be issued for successful completion of the study programme. The diploma for the master's degree programme in Mathematics contains
a) a list of all modules, the chosen focus area or subjects according to § 7 above and their assessments;
b) the title and the assessment of the master's thesis;
c) the assessment of the final examination before a committee;

d) the entirety of the ECTS credit points for the free-choice subject according to § 9 above, and
e) the overall assessment according to § 73 para. 3 UG.

§ 14 Transitional provisions

(1) The following transitional provisions apply to students at Uni Graz:

When this curriculum comes into effect on 01.10.2015, students of the master's degree programmes in Allgemeine Mathematik (curriculum 2006 in the version 2007), Numerische Mathematik und Modellierung (curriculum 2006 in the version 2007) and Mathematische Computerwissenschaften (curriculum 2006 in the version 2008) are entitled to continue and complete their studies until 30.09.2018 according to the provisions of the individually applicable curriculum. If the study programme is not completed by 30.09.2018, students are subject to this curriculum for the master's degree programme in Mathematics as amended.

(2) The following transitional provisions apply to students at TU Graz:

When this curriculum comes into effect on 01.10.2015, students of the master's degree programmes in Finanz- und Versicherungsmathematik (curriculum 2006), Mathematische Computerwissenschaften (2008), Technische Mathematik: Operations Research und Statistik (curriculum 2006) and Technomathematik (curriculum 2006) are entitled to continue and complete their studies until 30.09.2018 according to the provisions of the individually applicable curriculum. If the study programme is not completed by 30.09.2018, students are subject to this curriculum for the master's degree programme in Mathematics as amended.

(3) Students are entitled to voluntarily opt for the new curriculum at any time within the admission periods. To this end, a written irrevocable declaration must be sent to the officer responsible for study matters.

§ 15 Legal validity

This curriculum 2015 (abbreviated on UNIGRAZonline as 15W, and on TUGRAZonline as 15U) shall come into effect on 1 October 2015.

Annex to the curriculum for the master's degree programme in Mathematics

Annex I:

In the following table, the compulsory subjects of this curriculum are listed according to semester and focus area.

Curriculum

1st semester	SSt	Type	ECTS	Uni Graz	TU Graz
General compulsory subjects					
Advanced analysis	3	VO	4.5	x	x
Advanced analysis	1	UE	1.5	x	x
Discrete and algebraic structures	3	VO	4.5	x	x
Discrete and algebraic structures	1	UE	1.5	x	x
Total	**8**		**12**		
Focus area Applied Mathematics					
Advanced functional analysis	3	VO	4.5	x	x
Advanced functional analysis	1	UE	1.5	x	x
Non-linear optimisation	4	VO	6	x	
Non-linear optimisation	2	UE	3	x	
High-performance computing	2	VU	2.5	x	
Free-choice subject according to § 9 above			0.5		
Total			**18**		
Focus area Discrete Mathematics					
Advanced probability	3	VO	4.5		x
Advanced probability	1	UE	1.5		x
Number theory	3	VO	4.5	x	x
Number theory	1	UE	1.5	x	x
Discrete and computational geometry	3	VO	4.5		x
Discrete and computational geometry	1	UE	1.5		x
Total			**18**		
Focus area Financial and Actuarial Mathematics					
Advanced probability	3	VO	4.5		x
Advanced probability	1	UE	1.5		x
Mathematical statistics	3	VO	4.5		x
Mathematical statistics	1	UE	1.5		x
Versicherungsvertragsrecht	2	VO	3	x	
Free-choice subject according to § 9 above			3	x	x
Total			**18**		
Focus area Statistics and Operations Research					
Advanced probability	3	VO	4.5		x
Advanced probability	1	UE	1.5		x
Mathematical statistics	3	VO	4.5		x
Mathematical statistics	1	UE	1.5		x
Operations Research	3	VO	4.5		x
Operations Research	1	UE	1.5		x

1st semester	SSt	Type	ECTS	Uni Graz	TU Graz
Total			**18**		
Focus area Technomathematics					
Advanced functional analysis	3	VO	4.5	x	x
Advanced functional analysis	1	UE	1.5	x	x
Numerical mathematics 4	3	VO	4		x
Numerical mathematics 4	1	UE	1.5		x
Free-choice subject according to § 9 above + elective subject according to § 8 above			6.5	x	x
Total	**8**		**18**		
Total for 1st semester			**30**		

2nd semester	SSt	Type	ECTS	Uni Graz	TU Graz
Focus area Applied Mathematics					
Partial differential equations and dynamical systems	4	VO	6	x	
Partial differential equations and dynamical systems	2	UE	3	x	
Numerics of partial differential equations	4	VO	6	x	
Numerics of partial differential equations	2	UE	3	x	
Mathematical modelling in the natural sciences	3	VO	4	x	
Mathematical modelling in the natural sciences	1	UE	1	x	
Scientific computing in mathematics	2	VU	2.5	x	
Free-choice subject according to § 9 above + elective subject according to § 8 above			4.5	x	x
Total			**30**		
Focus area Discrete Mathematics					
Mathematical foundations of information theory	3	VO	4.5		x
Mathematical foundations of information theory	1	UE	1		x
Commutative algebra	3	VO	4.5	x	x
Commutative algebra	1	UE	1.5	x	x
Advanced and algorithmic graph theory	3	VO	4.5		x
Advanced and algorithmic graph theory	1	UE	1.5		x
Analytic combinatorics	3	VU	4.5		x
Specialisation according to § 7[1] above			6	x	x
Free-choice subject according to § 9 above + elective subject according to § 8[1] above			2	x	x
Total			**30**		
Focus area Financial and Actuarial Mathematics					
Stochastic analysis	3	VO	4.5		x
Stochastic analysis	1	UE	1.5		x
Advanced actuarial mathematics	2	VO	3		x
Advanced actuarial mathematics	1	UE	1		x
Non-life insurance mathematics	2	VO	3		x
Non-life insurance mathematics	1	UE	1		x
Versicherungswirtschaftslehre	2	VO	3		x
Actuarial specialisation according to § 7 above			3		x
Free-choice subject according to § 9 above + elective subject according to § 8 above			10	x	x

2nd semester	SSt	Type	ECTS	Uni Graz	TU Graz
Total			**30**		
Focus area Statistics and Operations Research					
Regression analysis	3	VO	4		x
Regression analysis	1	UE	1.5		x
Combinatorial optimisation 2	3	VO	4.5		x
Combinatorial optimisation 2	1	UE	1.5		x
Specialisation according to § 7 above			6		x
Free-choice subject according to § 9 above + elective subject according to § 8 above			12.5	x	x
Total			**30**		
Focus area Technomathematics					
Partial differential equations and boundary value problems	3	VO	4.5		x
Partial differential equations and boundary value problems	1	UE	1.5		x
Numerics and simulation	3	VO	4		x
Numerics and simulation	1	UE	1.5		x
Calculus of variations	2	VO	3	x	x
Calculus of variations	1	UE	1	x	x
Specialisation according to § 7 above			6		x
Free-choice subject according to § 9 above + elective subject according to § 8 above			8.5	x	x
Total			**30**		

3rd semester	SSt	Type	ECTS	Uni Graz	TU Graz
Focus area Applied Mathematics					
Inverse problems	3	VO	4.5	x	
Inverse problems	1	UE	1.5	x	
Stochastic models	3	VO	4.5	x	
Stochastic models	1	UE	1.5	x	
Seminar	2	SE	4	x	x
Free-choice subject according to § 9 above + elective subject according to § 8 above			13	x	x
Total			**29**		
Focus area Discrete Mathematics					
Algebraic curves and cryptography	3	VU	4.5	x	x
Probabilistic method in combinatorics and algorithmics	3	VU	4.5		x
Specialisation according to § 7[1] above			6	x	x
Seminar	2	SE	4	x	x
Free-choice subject according to § 9 above + elective subject according to § 8[1] above			10	x	x
Total			**29**		
Focus area Financial and Actuarial Mathematics					
Advanced financial mathematics	3	VO	4.5		x
Advanced financial mathematics	1	UE	1.5		x
Risk theory and management in actuarial science	3	VO	4.5		x
Risk theory and management in actuarial science	1	UE	1.5		x
Project in finance and insurance	2	PR	5		x

3rd semester	SSt	Type	ECTS	Uni Graz	TU Graz
Actuarial specialisation according to § 7 above			3	x	x
Seminar	2	SE	4	x	x
Free-choice subject according to § 9 above + elective subject according to § 8 above			5		
Total			**29**		
Focus area Statistics and Operations Research					
Non-linear optimisation	4	VO	6	x	
Non-linear optimisation	2	UE	3	x	
Applied statistics	3	VO	4.5		x
Applied statistics	1	UE	1.5		x
Project statistic and operations research	2	PR	4.5		x
Seminar	2	SE	4	x	x
Free-choice subject according to § 9 above + elective subject according to § 8 above			5.5	x	x
Total			**29**		
Focus area Technomathematics					
Mathematical modelling in engineering	4	VO	6		x
Inverse problems	3	VO	4.5	x	
Inverse problems	1	UE	1.5	x	
Project Technomathematics	2	PR	4		x
Specialisation according to § 7 above			6		x
Seminar	2	SE	4	x	x
Free-choice subject according to § 9 above + elective subject according to § 8 above			3	x	x
Total			**29**		

4th semester	SSt	Type	ECTS	Uni Graz	TU Graz
Master's thesis			**30**	x	x
Master's degree examination			**1**	x	x
Total			**31**		

Total ECTS for courses, compulsory subjects and elective subjects	**83**
Total ECTS for free-choice subject	**6**
Total ECTS	**120**

[1]The specialisation in the focus area Discrete Mathematics can be completed in either the 2nd or the 3rd semester. In the semester in which the specialisation is not completed, additional courses with a total scope of 6 ECTS credit points must be completed as part of the free-choice subject according to § 9 above and/or elective subject according to § 8 above.

Abbreviations: PR: project; SE: seminar; SSt: semester hours/contact hours; UE: exercise; VO: lecture; VU: lecture with integrated exercises

Annex II:

Module descriptions

Module A Advanced Analysis	
ECTS credit points	6
Subject content	Differential calculus in normed spaces, fixed-point theorems, Fourier analysis, analysis on manifolds
Learning outcomes	After completing the module, students are able to • apply basic methods and concepts of non-linear analysis in normed spaces in a problem-orientated way; • formulate problems of non-linear analysis as fixed-point problems; • apply fixed-point theorems suitably; • apply methods and concepts of Fourier analysis adeptly, and • understand and apply essential concepts of differentiable manifolds.
Teaching and learning activities and methods	The module consists of a lecture and an accompanying exercise; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using assignments to be solved independently.
Prerequisites	None
Frequency with which the module is offered	Every year

Module B Discrete and algebraic structures	
ECTS credit points	6
Subject content	Standard methods of enumerative combinatorics, graph theory, rings and modules, multilinear algebra
Learning outcomes	After completing the module, students are able to • apply generating functions as methods of enumerative combinatorics; • apply analytical techniques for asymptotic statements of combinatorics; • apply basic concepts of graph theory to solve discrete problems; • understand and apply essential tools of commutative algebra, such as commutative diagrams and exact sequences, and • apply multilinear maps and tensor products as tools in multidimensional analysis and algebra.
Teaching and learning activities and methods	The module consists of a lecture and an accompanying exercise; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using assignments to be solved independently.
Prerequisites	None
Frequency with which the module is offered	Every year

Module Focus area Applied Mathematics	
ECTS credit points	55
Subject content	Partial differential equations: advanced techniques for stationary and non-stationary problems, numerical methods; advanced programming techniques; theory and numerics of constrained non-linear optimisation problems; deterministic and stochastic mathematical models and their analysis; theory and numerics of inverse problems
Learning outcomes	After completing the module, students are able to • formulate mathematical models for complex processes; • analyse the developed models; • choose suitable numerical methods for the numerical solution of the models; • use modern hardware, compiler and algorithmic possibilities to accelerate numerical applications at the best possible rate; • handle non-linear optimisation problems with constraints with problem-orientated methods, and • solve inverse problems and mathematical image-processing problems.
Teaching and learning activities and methods	The module consists of several lectures and accompanying exercises; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using examples to be solved independently. Some specialised courses will be held as lectures with integrated exercises.
Prerequisites	Knowledge of analysis, linear algebra and numerical mathematics at bachelor's level
Frequency with which the module is offered	Every year

Module Focus area Discrete Mathematics	
ECTS credit points	55
Subject content	Further education in stochastics; introduction to information theory; introduction to the probabilistic method in combinatorics and algorithmics; courses to deepen knowledge of commutative algebra; algebraic curves and number theory with applications in cryptography; discrete geometry and specialisation in graph theory with algorithmic aspects. A specialisation in non-commutative algebra, combinatorial optimisation or complexity theory can also be chosen.
Learning outcomes	After completing the module, students are able to • understand basic concepts of commutative algebra; • understand basic concepts of stochastics and information theory and apply them to discrete mathematics questions; • understand concepts of algebraic, analytical and additive number theory; • handle the algebraic and number theoretical basics of cryptographic applications; • apply methods of discrete and algorithmic geometry and graph theory, and • analyse discrete and combinatorial structures with asymptotic and probabilistic methods.
Teaching and learning activities and methods	The module consists of several lectures and accompanying exercises; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using examples to be solved independently. Some further courses will be held as lectures with integrated exercises.
Prerequisites	Knowledge of algebra, discrete mathematics and probability theory at bachelor's level
Frequency with which the module is offered	Every year

Module Focus area Statistics and Operations Research	
ECTS credit points	55
Subject content	Further education in statistics and operations research. Description of central concepts and methods in the areas of mathematical and applied statistics and statistical modelling. Broadened knowledge in the area of non-linear optimisation with constraints. Deepened knowledge of combinatorial optimisation with the focus on NP-hard problems. Broadened knowledge of operations research methods (metaheuristics, multicriteria optimisation).
Learning outcomes	After completing the module, students are able to • create and analyse mathematical models for problems in the areas of operations research and statistics; • choose and implement suitable methods to solve these; • use modern tools and program packages in the areas of operations research and statistics; • statistically analyse complex data structures; • solve difficult combinatorial optimisation problems exactly and approximately, and • handle non-linear optimisation problems with constraints.
Teaching and learning activities and methods	The module consists of several lectures and accompanying exercises; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using examples to be solved independently. In the project, students are provided with knowledge and experience of analysis, modelling and solving problems in the areas of optimisation and statistics.
Prerequisites	Knowledge of discrete mathematics, optimisation, statistics and probability theory at bachelor's level
Frequency with which the module is offered	Every year

Module Focus area Financial and Actuarial Mathematics	
ECTS credit points	55
Subject content	Basics of probability theory, mathematical statistics and stochastic analysis; basics of insurance law and financial management; mathematical finance modelling, arbitrage theory, derivative valuations, yield curve models and valuation of interest rate derivatives; risk theory and credit risk models; mathematical models in reinsurance; ruin theory; non-life insurance mathematics; bonus-malus systems; life insurance mathematics; longevity risks and catastrophe risks in life insurance.
Learning outcomes	After completing the module, students are able to • understand and analyse complex mathematical finance and insurance models; • implement these in a practice-orientated way by means of modern software packages, and • critically assess the strengths and weakness of the models covered. After completing the module, students have a broad knowledge • of non-life and life insurance mathematics; • of risk management; • in the valuation of financial products in the banking sector, and • are familiar with the legal and financial management basics of the insurance and banking sectors.
Teaching and learning activities and methods	The module consists of several lectures and accompanying exercises; in the lectures, the material will be presented theoretically; in the accompanying exercises, the material will be presented in more depth using examples to be solved independently. As part of a project, a practical mathematical problem in finance or insurance will be tackled.
Prerequisites	Knowledge of linear algebra, analysis and stochastics at bachelor's level.
Frequency with which the module is offered	Every year

Module Focus area Technomathematics	
ECTS credit points	55
Subject content	Analysis and numerics of partial differential equations; functional analysis and calculus of variations; modelling and simulation of physical and technical problems in natural sciences and engineering.
Learning outcomes	After completing the module, students • are familiar with abstract concepts of analysis, particularly functional analysis, topology, and modelling with differential equations; • have broadened their knowledge of numerical mathematics, particularly the application of modern numerical approximation methods, and numerical solutions to complex tasks; • have learnt the theoretical basics of technomathematics and are able to apply suitable analytical and numerical solution methods; • are able to formulate, analyse and solve mathematical models of physical and technical problems, and • have gained an insight into typical areas of application in science and technology.
Teaching and learning activities and methods	The module consists of several lectures and accompanying exercises; in the lecture, the material will be presented theoretically; in the exercise, the material will be presented practically and in more depth using examples to be solved independently; a seminar prepares students for independent development and presentation of research-related mathematical topics; a project connects the analytical preparation of a practical task with the numerical solution and its practical application for simulation.
Prerequisites	Knowledge of analysis, linear algebra and numerical mathematics at bachelor's level; basic knowledge of mechanics and electrical engineering.
Frequency with which the module is offered	Every year

Module Seminar	
ECTS credit points	4
Subject content	Current scientific topics from the individual focus areas.
Learning outcomes	After completing the module, students are able to • independently use specialist literature; • complete an independent written summary of a scientific topic, and • present a scientific topic to an audience familiar with the subject.
Teaching and learning activities and methods	Preparation of an assigned scientific topic using specialist literature, completion of a written seminar paper and the concluding presentation.
Prerequisites	Completion of most of the courses of the first two semesters
Frequency with which the module is offered	At least one seminar per focus area is offered every year

Annex III:

Recommended free-choice courses

Free-choice courses can be freely chosen from the courses offered at any recognised Austrian and foreign universities, and Austrian universities of applied sciences and university colleges for education according to § 9 of this curriculum.
In order to broaden students' basic knowledge in the subjects of this study programme, courses in foreign languages, social competence, technology assessment and women's and gender studies are recommended. In particular, we would like to refer students to the courses offered by the TU Graz service department Languages, Key Competencies and In-House Training or treffpunkt sprachen – Centre for Language, Plurilingualism and Didactics of Uni Graz, the Centre for Social Competence of Uni Graz, the Centre of Entrepreneurship and Applied Business Studies, as well as the Inter-University Research Centre for Technology, Work and Culture (IFZ).

Annex IV:

Recognition of courses

(1) The following table regulates the recognition of courses between the expiring curricula for master's degree programmes at Uni Graz in Allgemeine Mathematik 2006 in the version 2007 and Numerische Mathematik und Modellierung 2006 in the version 2007 and this curriculum. In the table, "↔" means the equivalence of both courses and "→" means the recognition of the course in the left-hand column of the table for the course in the right-hand column.

Course from the expiring curricula	Type	ECTS	SSt		Course from the curriculum 2015	Type	ECTS	SSt
Topologie	VO	4	3	↔	Advanced analysis	VO	4.5	3
Partielle Differentialgleichungen	VO	6	4	↔	Partial differential equations and dynamical systems	VO	6	4
Partielle Differentialgleichungen	PS	3	2	↔	Partial differential equations and dynamical systems	UE	3	2
Funktionalanalysis	VO	4.5	3	↔	Advanced functional analysis	VO	4.5	3
Algebra II	VO	6	4	→	Commutative algebra	VO	4.5	3
Algebra II	PS	3	2	→	Commutative algebra	UE	1.5	1
Zahlentheorie	VO	6	4	→	Number theory	VO	4.5	3
Zahlentheorie	PS	3	2	→	Number theory	PS	1.5	1
Numerische Mathematik II	VO	6	4	→	Numerical mathematics 4	VO	4	3
Numerische Mathematik II	PS	3	2	→	Numerical mathematics 4	UE	1.5	1
Numerik partieller Differentialgleichungen	VO	4.5	3	↔	Numerics of partial differential equations	VO	6	4
Numerik partieller Differentialgleichungen	PS	1.5	1	↔	Numerics of partial differential equations	UE	3	2
Optimierung II	VO	6	4	↔	Non-linear optimisation	VO	6	4
Optimierung II	PS	3	2	↔	Non-linear optimisation	UE	3	2
Objektorientiertes Programmieren	VU	3	2	↔	Scientific Computing in mathematics	VU	2.5	2
Mathematische Modellierung II	VO	6	4	→	Mathematical modelling in the natural sciences	VO	4	3
Mathematische Modellierung II	PS	3	2	→	Mathematical modelling in the natural sciences	UE	1	1
High-Performance Computing	VU	4	2	↔	High-Performance Computing	VU	2.5	2

Abbreviations: PS: proseminar; SSt: semester hours/contact hours; UE: exercise; VO: lecture; VU: lecture with integrated exercises

(2) The following table regulates the recognition of courses between the expiring curricula for the master's degree programmes at TU Graz in Finanz- und Versicherungsmathematik 2006, Technische Mathematik: Operations Research und Statistik 2006 and Technomathematik 2006, as well as the expiring curriculum at both universities for Mathematische Computerwissenschaften 2008 and this curriculum. In the table, "↔" means the equivalence of both courses and "→" means the recognition of the course in the left-hand column of the table for the course in the right-hand column.

Course from the expiring curricula	Type	ECTS	SSt		Course from the curriculum 2015	Type	ECTS	SSt
Höhere Analysis	VO	5	3	↔	Advanced analysis	VO	4.5	3
Höhere Analysis	UE	1	1	↔	Advanced analysis	UE	1.5	1
Diskrete Stochastik und Informationstheorie	VO	4	3	↔	Mathematical foundations of information theory	VO	4.5	3
Diskrete Stochastik und Informationstheorie	UE	1	1	↔	Mathematical foundations of information theory	UE	1	1
Algebra und Zahlentheorie	VO	6	4	→	Number theory	VO	4.5	3
Algebra und Zahlentheorie	UE	3	2	→	Number theory	UE	1.5	1
Theoretische Informatik II	VO	4	3	↔	Complexity theory	VO	4.5	3

Course from the expiring curricula	Type	ECTS	SSt		Course from the curriculum 2015	Type	ECTS	SSt
Theoretische Informatik II	UE	1	1	↔	Complexity theory	UE	1.5	1
Einführung in algebraische Kurven	VO	4.5	3	↔	Algebraic curves and cryptography	VU	4.5	3
Einführung in algebraische Kurven	UE	1.5	1					
Algorithmische Graphentheorie	VO	4.5	3	↔	Advanced and algorithmic graph theory	VO	4.5	3
Algorithmische Graphentheorie	UE	1.5	1	↔	Advanced and algorithmic graph theory	UE	1.5	1
Kommutative Algebra	VO	4.5	3	↔	Commutative algebra	VO	4.5	3
Kommutative Algebra	UE	1.5	1	↔	Commutative algebra	UE	1.5	1
Kombinatorische Optimierung 2	VO	6	4	↔	Combinatorial optimisation 2	VO	4.5	3
Kombinatorische Optimierung 2	UE	1	1	↔	Combinatorial optimisation 2	UE	1.5	1
Partielle Differentialgleichungen 2	VO	5	3	↔	Partial differential equations and boundary value problems	VO	4.5	3
Partielle Differentialgleichungen 2	UE	1	1	↔	Partial differential equations and boundary value problems	UE	1.5	1
Angewandte Statistik	VO	4	3	↔	Applied statistics	VO	4.5	3
Angewandte Statistik	UE	2	1	↔	Applied statistics	UE	1.5	1
Numerik und Simulation	VO	5	3	↔	Numerics and simulation	VO	4	3
Numerik und Simulation	UE	1	1	↔	Numerics and simulation	UE	1.5	1
Numerische Mathematik 4	VO	4	3	↔	Numerical mathematics 4	VO	4	3
Numerische Mathematik 4	UE	2	1	↔	Numerical mathematics 4	UE	1.5	1
Mathematische Modellierung 2	VO	6	4	↔	Mathematical modelling in engineering	VO	6	4
Höhere Finanzmathematik	VO	5	3	↔	Advanced financial mathematics	VO	4.5	3
Höhere Finanzmathematik	UE	1	1	↔	Advanced financial mathematics	UE	1.5	1
Versicherungsrecht	VO	6	4	→	Versicherungsvertragsrecht	VO	3	2
Versicherungswirtschaftslehre	VO	3	2	↔	Versicherungswirtschafts-lehre	VO	3	2
Höhere Wahrscheinlichkeitstheorie	VO	4	2	↔	Advanced probability	VO	4.5	3
Höhere Wahrscheinlichkeitstheorie	UE	1	1	↔	Advanced probability	UE	1.5	1
Mathematische Statistik	VO	3	2	↔	Mathematical statistics	VO	4.5	3
Mathematische Statistik	UE	2	1	↔	Mathematical statistics	UE	1.5	1
Stochastische Analysis	VO	3	2	↔	Stochastic analysis	VO	4.5	3
Stochastische Analysis	UE	1	1	↔	Stochastic analysis	UE	1.5	1
Höhere Versicherungsmathematik	VO	5	3	↔	Advanced actuarial mathematics	VO	3	2

Course from the expiring curricula	Type	ECTS	SSt		Course from the curriculum 2015	Type	ECTS	SSt
Höhere Versicherungsmathematik	UE	1	1	↔	Advanced actuarial mathematics	UE	1	1
Risikotheorie und -management	VO	3	2	↔	Risk theory and management in actuarial science	VO	4.5	3
Operations Research	VO	4	3	↔	Operations Research	VO	4.5	3
Operations Research	UE	2	1	↔	Operations Research	UE	1.5	1
Nichtlineare Optimierung	VO	6	4	↔	Non-linear optimisation	VO	6	4
Nichtlineare Optimierung	UE	3	2	↔	Non-linear optimisation	UE	3	2

Abbreviations: SSt: semester hours/contact hours; UE: exercise; VO: lecture; VU: lecture with integrated exercises

(3) Recognitions of courses from the expiring curricula that are not included in the tables under (1) and (2) shall be approved by the respective officer responsible for study matters.

(4) Courses from the expiring curricula for master's degree programmes which will no longer be offered after this curriculum has come into effect, and which are not included in the tables under (1) and (2), can be replaced by courses from this curriculum after consultation with the officer responsible for study matters.

Annex V:

Glossary of the names used, which are different in the statutes and guidelines of both universities

Name in this curriculum (NAWI Graz)	Name at Uni Graz	Name at TU Graz
module	Modul	Fach/Modul
SSt (semester hour)	KStd.	SSt
elective subject	Gebundes Wahlfach	Wahlfachkatalog
free-choice subject	Freie Wahlfächer	Freifach