Curriculum for the Master's Degree Programme

Software Engineering and Management

Curriculum 2020 in the version of 2024

This version of the curriculum was approved by the Senate of Graz University of Technology during its meeting on 27 May 2024.

The legal bases of this degree programme are the Universities Act 2002 (UG) and the Excerpt of Statutes: Legal Regulations for Academic Affairs of 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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I General

§ 1 Object of degree programme und the qualification profile

The Master's Degree Programme Software Engineering and Management comprises four semesters. The total scope of the programme is 120 ECTS credit points, pursuant to § 54 (3) of the Universities Act (UG).

This Master's Degree Programme Software Engineering and Management is taught as a degree programme in a foreign language in English, according to § 63a (8) of the Universities Act (UG).

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

Object of degree programme

Software engineering focuses on the basics of and technologies for systematically manufacturing and developing software. Students learn the principles, methods and tools for the engineering development and application of complex and large-scale software systems. Software engineering covers the entire process, from identifying the requirements to implementing and maintaining an IT solution. The objective is a punctual supply of dependable software with guaranteed quality characteristics at calculated costs. To achieve this objective, the methods of practical computer science are combined with management methods.

For this reason, graduates of the Master's Degree Programme Software Engineering and Management are provided with in-depth technical and scientific expertise in the field of software development and also in-depth economic and scientific expertise in the field of management. The degree programme aims to provide a specialisation in selected topics while ensuring breadth and an interdisciplinary nature and increases students’ independence and initiative in the way they think, decide and act.

Students choose particular topics of software engineering and management for an independent specialisation of their skills. The following scientific areas are available for the specialisation: In the field of software engineering, these are:

- Algorithms and Theoretical Computer Science
- Games Engineering
- Data Science
- Information Security
- Intelligent Systems
- Interactive and Visual Information Systems
- Machine Learning
- Robotics
- Software Technology
- Visual Computing

and, in the field of management, these are:

- Business Informatics
- Industrial Management and Innovation
- Management and Strategy
- Management Control, Accounting and Finance
- Current Societies
- Cognition and Behaviour
- Digital Entrepreneurship
- Business Law

The degree programme aims to provide a high degree of freedom in choosing the teaching content. Of particularly high importance are topics with an integrative character, which combine several selected topics that are normally considered separately and help to develop an integrative approach to software systems.

A particular objective of this degree programme is therefore to develop the ability to think, decide and act in an interdisciplinary manner, and to develop an integrative approach to systems and therefore environmental and social issues, which are gaining in significance, especially with regard to increasing economic and social globalisation.

Information technologies contribute to globalisation and the expansion of the English language as the lingua franca of our world. This master's degree programme is therefore held in English, study periods abroad are encouraged, international doctoral students are integrated into the field of studies and visiting professors from the international community enrich the degree programme considerably and contribute to the development of social competence. Projects, lecture activities, written work and teamwork in groups further the development of the corresponding key competencies. Strategic thinking is developed as an integral element of the programme.

Qualification profile and skills

The Master’s Degree Programme Software Engineering and Management is awarded to students who have demonstrated the following knowledge, skills and competencies.

Knowledge and understanding

The graduates

- have developed a deep understanding of the relevant basics of software engineering.
- have developed a deep understanding of the relevant basics of management,
- are familiar with the key theories, principles and methods of software engineering, and have deepened their knowledge in one of the abovementioned scientific fields of software engineering.
- are familiar with the key theories, principles and methods of management, and have deepened their knowledge in one of the abovementioned scientific fields of management.
- have acquired abilities for abstraction and analysis and the ability to think formally and algorithmically.
- have learnt to think and act in a business context.

Application of Knowledge
The graduates

- apply theoretical knowledge in a technical and scientific nature in a practical way in the field of software engineering.
- apply their knowledge and their skills to solve problems, including in new and unfamiliar situations.
- are able to describe and interpret special aspects, boundaries, terminology and schools of thought in their subject area.
- are able to do scientific work independently and are therefore qualified to proceed to a doctoral programme.

Professional Judgement
The graduates

- handle complex situations.
- formulate scientifically founded assessments, including on the basis of incomplete or limited information.

Communicative, organisational and social competencies
The graduates

- are competent in communication and presentation techniques.
- are able to write scientific texts.
- are flexible, able to adapt and to work in a team.
- can use learning strategies that enable them to further develop their knowledge independently.

Differentiation from other degree programmes in the field of information and telecommunication
The Master's Degree Programme Software Engineering and Management highlights the software tools and content of information systems, in other words information and knowledge. This degree programme thus occupies the side of the broad IT spectrum that is to be described by the term "soft." This is clearly different from the Master's Degree Programme Electrical and Information Engineering, which focus on devices, components and integrated hardware and software systems, being the "hard" side of the spectrum. The two subject-specific subject areas are contrasted by the Master's Degree Programme Information and Computer Engineering as a generalist degree programme, in which a compromise between specialisation and a broad spectrum of education and training is realised. In contrast to Computer Science, this degree programme is characterised by an economic education.

Need and relevance of the degree programme for science and for the labour market

Due to their theoretical and practical knowledge in the fields of natural sciences and economics, graduates of the Master's Degree Programme Software Engineering and Management are able to think in an abstract and interdisciplinary way. The acquired

knowledge and the learned methodically structured procedure enable an independent implementation of tasks in software solutions. As a result, it is widely used in industry, services, public administration, business, education and science.

II General Provisions

§ 2 Admission requirements

(1) The Master's Degree Programme Software Engineering and Management builds upon the content of the Bachelor's Degree Programme Software Engineering and Management of Graz University of Technology. Graduates of this bachelor's degree thus meet the admission requirements for the Master's Degree Programme Software Engineering and Management. Furthermore, the following degree programmes are eligible for admission to the Master's Degree Programme Software Engineering and Management without further requirements:

a. Bachelor's Degree Programme Computer Science of Graz University of Technology
b. Bachelor's Degree Programme Information and Computer Engineering of Graz University of Technology
c. Bachelor's degree programmes in computer science, applied computer science, business informatics, software and information engineering, computer engineering or artificial intelligence completed at any other Austrian university or university of applied science

(2) Any degree programmes that are not mentioned in (1) are considered eligible for admission if at least 120 ECTS credit points have been positively completed in the following subject areas:

a. 30 ECTS credit points from courses on mathematics
b. 15 ECTS credit points from courses on theoretical computer science
c. 30 ECTS credit points from courses on applied computer science

(3) Any degree programmes that are not mentioned in (1) and that do not meet the requirements of (2) are not considered equivalent to a subject-related degree programme. If at least 90 ECTS credit points have been completed in the subject areas mentioned in (2), full equivalence may be established by requiring supplementary examinations. Additional completion of supplementary examinations may be required to the extent of a maximum of 30 ECTS credit points. Supplementary examinations worth a maximum of 5 ECTS credit points may be recognised as free-choice subjects for this master's degree programme.

(4) Any degree programmes that are not mentioned in (1) and do not meet the requirements of (2) and (3) are not close enough in subject matter to establish full equivalency. In such cases, admission to the Master's Degree Programme Computer Science is not possible.

(5) Proof of sufficient English language skills is a prerequisite for admission to the degree programme. The type of proof required is specified in a regulation issued by the Rectorate.

§ 3 Allocation of ECTS credit points

All study activities completed by the students are allocated certain numbers of ECTS credit points. ECTS credit points reflect the workload of each course or assignment relative to the workload of an academic year, which is intended to be 1500 real hours corresponding to 60 ECTS credit points (i.e., 25 actual hours per 1 ECTS credit). This workload includes both the time spent in self-study and the semester course hours. A ‘semester course hour’ is 45 minutes per teaching week of a semester.

§ 4 Structure of the degree programme

The Master's Degree Programme Software Engineering and Management with a workload of 120 ECTS credit points covers four semesters and is structured in modules, as follows: It is comprised of

1. a major in Software Engineering with a minimum of 50 ECTS credit points, of which at least 10 ECTS and a maximum of 15 ECTS credit points from seminars and/or projects of the major module group,
2. a minor in Management with a minimum of 20 ECTS credit points,
3. an elective subject, which contains courses of up to 14 ECTS credit points from any Management module group, resulting in a total of at least 84 ECTS credit points for the total of major, minor and elective subject. A larger number of achievements from items 1 and 2 therefore reduces the required number of achievements from the elective subject.
4. a free-choice subject that encompasses free-choice courses with a workload of 6 ECTS credit points, and
5. a master's thesis. The master's thesis corresponds to 30 ECTS credit points. It is to be assigned to the major according to § 4.1 or the minor according to § 4.2, cf. § 11.2.

	ECTS
Major from the Software Engineering module groups A–J (with 10-15 ECTS allocated to seminars/projects)	min. 50
Minor from the Management module groups K–R	min. 20
Elective subject: courses from the Management module groups K–R (to be assessed together with the minor)	max. 14
Free-choice courses	6
Master’s thesis	30
Total	120

§ 5 Types of courses

The types of courses provided at TU Graz are set out in § 4 of the Excerpt of Statutes: Legal Regulations for Academic Affairs of TU Graz (see Appendix IV).

§ 6 Group size

Lecture (VO) Lecture part of VU Orientation course (OL)	no restriction
Exercise (UE) Lecture part of VU	25 25
Laboratory course (LU)	6
Seminar (SE) Project (PT) Seminar project (SP)	15 15 15

§ 7 Guidelines for the allocation of places on courses

(1) If the number of students exceeds the number of available places, parallel courses are to be provided. If necessary, these parallel courses may also be provided during the holidays and semester breaks.

(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. This course is a compulsory part of the curriculum for the student.

b. The total of the courses already completed in the student's current degree programme (total of ECTS credit points)

c. The date on which the student fulfilled the participation criteria for the course (earlier date = higher priority).

d. Students who were not admitted to an earlier instance of the course or who have to repeat the course, should be admitted preferentially to the next instance of the course.

e. The grade of the examination – or the grade average of examinations (weighted by ECTS credit points) – in the course(s) required to be completed as admission criteria.

f. Students for whom this type of course is not required in order to complete their curriculum, will only be admitted according to the availability of free places; they can be entered into a separate waiting list. The above rules apply among them also.

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

III Course Content and Structure

§ 8 Modules, courses und semester allocation

The individual courses of this master's degree programme and their structure are stipulated as follows: Students must choose one module group from the module groups A-J in the table below as major and one module group from the module groups K-R in the table below as minor.

In the major, the Compulsory Modules “Compulsory 1” and “Compulsory 2” need to be completed in their entirety. Further ECTS credit points may be selected from the course catalogue of the elective module group. In addition, up to 4 ECTS credit points may be selected from the Elective Module S “Science, Technology and Society”. A total of 50 ECTS credit points is to be completed in the major.

In the minor, the Compulsory Module “Compulsory 1” needs to be completed in its entirety. Further ECTS credit points may be selected from the course catalogue of the elective module group. A total of 20 ECTS credit points is to be completed in the minor.

Courses already credited for a bachelor’s degree programme may not be credited again for a compulsory module. In such case, they are to be replaced by any courses in the course catalogue of the respective module group to the same extent of ECTS credit points.

The course catalogues of the elective module groups are specified in § 9. The description of the knowledge, methods or skills to be taught in the modules are described in more detail in Appendix I. The assignment of courses to particular semesters is a recommendation and ensures that the sequence of courses is best able to build on prior knowledge and that the workload of an academic year does not exceed 60 ECTS credit points. The fourth semester is dedicated to the writing of the master's thesis.

Master's Degree Programme Software Engineering and Management, Module Groups

Mod.	Course	SSt	Type	ECTS	Sem. ECTS credit points I	II	III	IV
Module Group A: Algorithms and Theoretical Computer Science								
Compulsory Module A1: Algorithms and Theoretical Computer Science – Compulsory 1								
A1.1	Enumerative Combinatoric Algorithms	2	VU	3.5		3.5		
A1.2	Discrete Stochastics and Information Theory (Computer Science)	3	VO	4.5		4.5		
A1.3	Discrete Stochastics and Information Theory	1	UE	1		1		
Subtotal Compulsory Module A1		**6**		**9**		**9**		
Compulsory Module A2: Algorithms and Theoretical Computer Science – Compulsory 2								
A2.1	Discrete and Computational Geometry	3	VO	4.5	4.5			
A2.2	Discrete and Computational Geometry	1	UE	1.5	1.5			
A2.3	Combinatorial Optimization 1	4	VO	6	6			
A2.4	Combinatorial Optimization 1	1	UE	1.5	1.5			
Subtotal Compulsory Module A2		**9**		**13.5**	**13.5**			
Total Compulsory Modules A		**15**		**22.5**				
Elective Modules A3–A7				**27.5**				
Subtotal Algorithms and Theoretical Computer Science				**50**				
Module Group B: Data Science								
Compulsory Module B1: Data Science – Compulsory 1								
B1.1	Knowledge Discovery & Data Mining 1	2	VO	3		3		
B1.2	Knowledge Discovery & Data Mining 1	1	KU	1.5		1.5		
B1.3	Data Integration and Large-Scale Analysis	3	VU	5	5			
Subtotal Compulsory Module B1		**6**		**9.5**	**5**	**4.5**		
Compulsory Module B2: Data Science – Compulsory 2								
B2.1	Architecture of Machine Learning Systems	3	VU	5		5		
B2.2	Data Analysis and Introduction to R	2	VO	3	3			
B2.3	Data Analysis and Introduction to R	1	UE	2	2			
Subtotal Compulsory Module B2		**6**		**10**	**5**	**5**		
Total Compulsory Modules B		**12**		**19.5**				
Elective Modules B3–B7				**30.5**				
Subtotal Data Science				**50**				
Module Group C Games Engineering:								
Compulsory Module C1: Games Engineering – Compulsory 1								
C1.1	Game Design and Development	3	VU	5	5			
C1.2	Real-Time Graphics	2	VO	3	3			
C1.3	Real-Time Graphics	1	KU	2	2			
Subtotal Compulsory Module C1		**6**		**10**	**10**			
Compulsory Module C2: Games Engineering – Compulsory 2								
C2.1	Game Design and Development II	3	VU	5		5		
C2.2	Simulation and Animation	3	VU	5		5		

Master's Degree Programme Software Engineering and Management, Module Groups								
Mod.	Course				Sem. ECTS credit points			
		SSt	Type	ECTS	I	II	III	IV
Subtotal Compulsory Module C2		**6**		**10**		**10**		
Total Compulsory Modules C		**12**		**20**				
Elective Modules C3–C6				**30**				
Subtotal Games Engineering				**50**				
Module Group D: Information Security								
Compulsory Module D1: Information Security – Compulsory 1								
D1.1	Secure Software Development	2	VO	3	3			
D1.2	Secure Software Development	1	KU	2	2			
D1.3	Cryptography	2	VO	3	3			
D1.4	Cryptography	1	KU	2	2			
Subtotal Compulsory Module D1		**6**		**10**	**10**			
Compulsory Module D2: Information Security – Compulsory 2								
D2.3	Verification and Testing	2	VO	3	3			
D2.4	Verification and Testing	1	UE	2	2			
D2.5	Secure Application Design	2	VO	3		3		
D2.6	Secure Application Design	1	KU	2		2		
Subtotal Compulsory Module D2		**6**		**10**	**5**	**5**		
Total Compulsory Modules D		**12**		**20**				
Elective Modules D3–D7				**30**				
Subtotal Information Security				**50**				
Module Group E: Intelligent Systems								
Compulsory Module E1: Intelligent Systems – Compulsory 1								
E1.1	Intelligent Systems	2	VO	3		3		
E1.2	Intelligent Systems	1	KU	2		2		
E1.3	Knowledge Discovery & Data Mining 1	2	VO	3		3		
E1.4	Knowledge Discovery & Data Mining 1	1	KU	1.5		1.5		
Subtotal Compulsory Module E1		**6**		**9.5**		**9.5**		
Compulsory Module E2: Intelligent Systems – Compulsory 2								
E2.1	Natural Language Processing	3	VU	5		5		
E2.2	Intelligent User Interfaces	3	VU	5		5		
Subtotal Compulsory Module E2		6		**10**		**10**		
Total Compulsory Modules E		**12**		**19.5**				
Elective Modules E3–E7				**30.5**				
Subtotal Intelligent Systems				**50**				
Module Group F: Interactive and Visual Information Systems								
Compulsory Module F1: Interactive and Visual Information Systems – Compulsory 1								
F1.1	Designing Interactive Systems	2	VU	3		3		

Master's Degree Programme Software Engineering and Management, Module Groups								
Mod.	**Course**				**Sem. ECTS credit points**			
		SSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
F1.2	Digital Libraries	2	VU	3.5	3.5			
F1.3	Information Search and Retrieval	3	VU	5	5			
Subtotal Compulsory Module F1		**7**		**11.5**	**8.5**	**3**		
Compulsory Module F2: Interactive and Visual Information Systems – Compulsory 2								
F2.1	Advanced Information Retrieval	3	VU	5	5			
F2.2	Evaluation Methodology	2	VU	3	3			
Subtotal Compulsory Module F2		5		**8**	**8**			
Total Compulsory Modules F		**12**		**19.5**				
Elective Modules F3–F6				**30.5**				
Subtotal Interactive and Visual Information Systems				**50**				
Module Group G: Machine Learning								
Compulsory Module G1: Machine Learning – Compulsory 1								
G1.1	Machine Learning 2	2	VO	3		3		
G1.2	Machine Learning 2	1	KU	2		2		
G1.3	Deep Learning	2	VO	3	3			
G1.4	Deep Learning	1	KU	2	2			
Subtotal Compulsory Module G1		**6**		**10**	**5**	**5**		
Compulsory Module G2: Machine Learning – Compulsory 2								
G2.1	Reinforcement Learning	2	VO	3	3			
G2.2	Reinforcement Learning	1	KU	2	2			
Subtotal Compulsory Module G2		**3**		**5**	**5**			
Total Compulsory Modules G		**9**		**15**				
Elective Modules G3–G7				**35**				
Subtotal Machine Learning				**50**				
Module Group H: Robotics								
Compulsory Module H1: Robotics – Compulsory 1								
H1.1	Advanced Robotics	2	VO	3		3		
H1.2	Advanced Robotics	1	LU	2		2		
H1.3	Mobile Robots	2	VO	3	3			
H1.4	Mobile Robots	1	UE	2	2			
Subtotal Compulsory Module H1		**6**		**10**	**5**	**5**		
Compulsory Module H2: Robotics – Compulsory 2								
H2.1	Intelligent Systems	2	VO	3		3		
H2.2	Intelligent Systems	1	KU	2		2		
H2.3	Robot Vision	2	VO	3		3		
H2.4	Robot Vision	1	KU	2		2		
Subtotal Compulsory Module H2		**6**		**10**		**10**		
Total Compulsory Modules H		**12**		**20**				
Elective Modules H3–H8				**30**				

Master's Degree Programme Software Engineering and Management, Module Groups								
Mod.	**Course**				**Sem. ECTS credit points**			
		SSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Subtotal Robotics				**50**				
Module Group I: Software Technology								
Compulsory Module I1: Software Technology – Compulsory 1								
I1.1	Software Technology	3	VU	5		5		
I1.2	Compiler Construction	2	VO	3		3		
I1.3	Compiler Construction	1	KU	2		2		
Subtotal Compulsory Module I1		**6**		**10**		**10**		
Compulsory Module I2: Software Technology – Compulsory 2								
I2.1	Design Patterns	2	VO	3	3			
I2.2	Design Patterns	1	UE	1.5	1.5			
I2.3	Verification and Testing	2	VO	3	3			
I2.4	Verification and Testing	1	UE	2	2			
Subtotal Compulsory Module I2		**6**		**9.5**	**9.5**			
Total Compulsory Modules I		**12**		**19.5**				
Elective Modules I3–I8				**30.5**				
Subtotal Software Technology				**50**				
Module Group J: Visual Computing								
Compulsory Module J1: Visual Computing – Compulsory 1								
J1.1	Geometric 3D-Modelling in Computer Graphics	3	VU	5		5		
J1.2	Image Processing and Pattern Recognition	2	VO	3	3			
J1.3	Image Processing and Pattern Recognition	1	KU	2	2			
Subtotal Compulsory Module J1		**6**		**10**	**5**	**5**		
Compulsory Module J2: Visual Computing – Compulsory 2								
J2.1	Real-Time Graphics	2	VO	3	3			
J2.2	Real-Time Graphics	1	KU	2	2			
J2.2	Robot Vision	2	VO	3		3		
J2.3	Robot Vision	1	KU	2		2		
Subtotal Compulsory Module J2		**6**		**10**	**5**	**5**		
Total Compulsory Modules J		**12**		**20**				
Elective Modules J3–J7				**30**				
Subtotal Visual Computing				**50**				
Module Group K: Business Informatics								
Compulsory Module K1: Business Informatics – Compulsory 1								
K1.1	Business Informatics	1	VO	1.5		1.5		
K1.2	Business Informatics	2	UE	3		3		
Subtotal Compulsory Module K1		**3**		**4.5**		**4.5**		
Total Compulsory Modules K		**3**		**4.5**				

Master's Degree Programme Software Engineering and Management, Module Groups								
Mod.	**Course**				**Sem. ECTS credit points**			
		SSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Elective Module K2				**15.5**				
Subtotal Business Informatics				**20**				
Module Group L: Industrial Management and Innovation								
Compulsory Module L1: Industrial Management and Innovation – Compulsory 1								
L1.1	Industrial Management and Innovation	2	VO	3	3			
L1.2	Industrial Management and Innovation	1	UE	1	1			
L1.3	Enabling Innovation	1	VO	1.5		1.5		
L1.4	Enabling Innovation	1	UE	1		1		
Subtotal Compulsory Module L1		**5**		**6.5**	**4**	**2.5**		
Total Compulsory Modules L		**5**		**6.5**				
Elective Module L2				**13.5**				
Subtotal Industrial Management and Innovation				**20**				
Module Group M: Management and Strategy								
Compulsory Module M1: Management and Strategy – Compulsory 1								
M1.1	Information Management	3	VU	4			4	
M1.2	General Management and Organisation	2	VO	2		2		
M1.3	General Management and Organisation	2	UE	3		3		
Subtotal Compulsory Module M1		**7**		**9**		**5**	**4**	
Total Compulsory Modules M		**7**		**9**				
Elective Module M2				**11**				
Subtotal Management and Strategy				**20**				
Module Group N: Management Control, Accounting and Finance								
Compulsory Module N1: Management Control, Accounting and Finance – Compulsory 1								
N1.1	Financial Management	2	VO	3		3		
N1.2	Management Control Systems	3	VO	4.5	4.5			
Subtotal Compulsory Module N1		**5**		**7.5**	**4.5**	**3**		
Total Compulsory Modules N		**5**		**7.5**				
Elective Module N2				**12.5**				
Subtotal Management Control, Accounting and Finance				**20**				

The courses in module groups O to R are mainly offered at the University of Graz in the framework of the [1]*Route-63 Initiative*. In order to complete these courses, co-registration at the University of Graz is required. Courses offered at the University of Graz (KFU) are

[1] https://www.tugraz.at/fakultaeten/infbio/studies/route-63

marked with the superscript letters[KFU]. The University of Graz is responsible for the implementation of these courses; therefore, in general and in particular, instead of the provisions in §§ 6, 7 and 14, the respective legal requirements of the University of Graz and also any prerequisites for participation in the course as stipulated in the curricula of the University of Graz apply. If one of these courses is not offered in an academic year or if the student is not allocated a place in a course with a limited number of participants, this course may be replaced by a course of Graz University of Technology in a similar subject area in agreement with the competent officers responsible for study matters.

Courses that are held in German (DE) only are marked with the superscript letters[DE].

Master's Degree Programme Software Engineering and Management, Module Groups								
Mod.	**Course**				**Sem. ECTS credit points**			
		SSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Module Group O: Digital Entrepreneurship								
Compulsory Module O1: Digital Entrepreneurship – Compulsory 1								
O1.1	Managing Touchpoints and the Customer Journey[KFU]	2	KS	4		4		
O1.2	Entrepreneurship	2	VO	3		3		
Subtotal Compulsory Module O1		**4**		**7**		**7**		
Total Compulsory Modules O				**7**				
Elective Module O2				**13**				
Subtotal Digital Entrepreneurship				**20**				
Module Group P: Cognition and Behaviour								
Compulsory Module P1: Cognition and Behaviour – Compulsory 1								
P1.1	Allgemeine Psychologie I[KFU, DE]	2	VO	3	3			
P1.2	Allgemeine Psychologie II[KFU, DE]	2	VO	3		3		
P1.3	Neuropsychologie[KFU, DE]	2	VO	3	3			
P1.4	Arbeits-, Organisations- und Umweltpsychologie[KFU, DE]	2	VO	3		3		
Subtotal Compulsory Module P1		**8**		**12**	**6**	**6**		
Total Compulsory Modules P				**12**				
Elective Module P2				**8**				
Subtotal Cognition and Behaviour				**20**				
Module Group Q: Current Societies								
Compulsory Module Q1: – Compulsory 1								
Q1.1	Hauptströmungen soziologischen Denkens[KFU, DE]	2	VO	4	4			
Q1.2	Grundzüge der Empirischen Sozialforschung[KFU, DE]	2	VO	4	4			
Q1.3	Einführung in die Soziologie[KFU, DE]	2	VO	4	4			
Subtotal Compulsory Module Q1		**6**		**12**	**12**			
Total Compulsory Modules Q				**12**				

Master's Degree Programme Software Engineering and Management, Module Groups							
Mod.	Course				Sem. ECTS credit points		
		SSt	Type	ECTS	I	II	III	IV
Elective Module Q2				**8**				
Subtotal Current Societies				**20**				
Module Group R: Business Law								
Compulsory Module R1: – Compulsory 1								
R1.1	Datenschutzrecht[KFU, DE]	2	KS	5	5			
Subtotal Compulsory Module R1		**2**		**5**	**5**			
Total Compulsory Modules R				**5**				
Elective Module R2:				**15**				
Subtotal Business Law				**20**				

§ 9 Elective modules

Elective modules with a selection of courses are defined for each module group. Courses already credited for a bachelor's degree programme may not be credited again for an elective module.

In the following course catalogues for elective modules, recommended courses are marked with the superscript letter[e]. These are bachelor-level courses that impart the basics for the module. They are therefore recommended if they have not yet been completed in a bachelor's degree programme. Courses that are held in German (DE) only are marked with the superscript letters[DE].

(1) Course Catalogue for Elective Module Group A: Algorithms and Theoretical Computer Science

Elective Module A3: Algorithms and Theoretical Computer Science – Algorithms					
Course		Course		Semester allocation	
	SSt	Type	ECTS	WS	SS
Design and Analysis of Algorithms[e]	3	VU	5	*5*	
Problem Analysis and Complexity Theory	3	VU	4.5		*4.5*
Algorithms and Games	1.5	VU	2	*2*	
Probabilistic Methods and Algorithms	3	VU	4.5	*4.5*	
Advanced and Algorithmic Graph Theory	3	VO	4.5		*4.5*
Advanced and Algorithmic Graph Theory	1	UE	1.5		*1.5*
Geometry for Computer Scientists	2	VU	3	*3*	
Distributed Algorithms	3	VU	5		*5*

Elective Module A4: Algorithms and Theoretical Computer Science – Optimisation

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Nonlinear Optimization[e]	3	VO	4.5	*4.5*	
Nonlinear Optimization[e]	2	UE	2.5	*2.5*	
Convex Optimization	3	VU	5		*5*
Operations Research	3	VO	4.5	*4.5*	
Operations Research	1	UE	2	*2*	
Combinatorial optimisation 2	3	VO	4.5		*4.5*
Combinatorial optimisation 2	1	UE	1.5		*1.5*

Elective Module A5: Algorithms and Theoretical Computer Science – Theoretical Computer Science

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Theoretische Informatik[e,DE]	2	VO	3		*3*
Theoretische Informatik[e,DE]	1	KU	1		*1*
Logic and Computability[e]	2	VO	3	*3*	
Logic and Computability[e]	1	KU	1	*1*	
Information Theory and Coding	2	VO	3	*3*	
Information Theory and Coding	1	UE	2	*2*	
Analytic Combinatorics	3	VU	4.5		*4.5*
Complexity Theory	3	VO	4.5	*4.5*	
Complexity Theory	1	UE	1	*1*	
Logic-Based Knowledge Representation	3	VU	4.5	*4.5*	
Advanced Information Theory	2	VU	3		*3*
Introduction to Quantum Computing	2	VO	3	*3*	

Elective Module A6: Algorithms and Theoretical Computer Science – Applications

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Mathematical Principles in Visual Computing	3	VU	5		*5*
Network Science	3	VU	5	*5*	
Verification and Testing	2	VO	3	*3*	
Verification and Testing	1	UE	2	*2*	
Number Theory	3	VO	4.5	*4.5*	
Number Theory	1	UE	1.5	*1.5*	
Model Checking	2	VO	3		*3*
Model Checking	1	UE	2		*2*
Formal Specification and Design of Software	3	VU	5	*5*	

Elective Module A7: Algorithms and Theoretical Computer Science – Projects and Seminars

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Algorithms	4	SP	10	*10*	*10*
Seminar (Discrete Mathematics and Theory of Algorithms)	2	SE	3.5		*3.5*
Seminar Algorithm Design 1	3	SE	5	*5*	

Elective Module A7: Algorithms and Theoretical Computer Science – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar Algorithm Design 2	3	SE	5		*5*
Seminar Theoretical Computer Science	3	SE	5		*5*

DE: This course is offered in German only.
e: Recommended course, unless it was already completed in the bachelor's degree programme.

(2) Course Catalogue for Elective Module Group B: Data Science

Elective Module B3: Data Science – Data Mining and Machine Learning					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Knowledge Discovery & Data Mining 2	3	VU	5	*5*	
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Machine Learning 2	2	VO	3		*3*
Machine Learning 2	1	KU	2		*2*
Nonlinear Optimization	3	VO	4.5	*4.5*	
Nonlinear Optimization	2	UE	2.5	*2.5*	
Deep Learning	2	VO	3	*3*	
Deep Learning	1	KU	2	*2*	
Visual Analytics	3	VU	5		*5*

Elective Module B4: Data Science – Data Management					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Architecture of Database Systems	3	VU	5	*5*	
Spatial Databases	2	VU	3	*3*	
Privacy Enhancing Technologies	2	VO	3	*3*	
Privacy Enhancing Technologies	1	KU	2	*2*	

Elective Module B5: Data Science – Social Data Science					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Computational Modelling of Social Systems	3	VU	4.5		*4.5*
Computational Social Systems 2	3	VU	5	*5*	
Network Science	3	VU	5	*5*	
Natural Language Processing	3	VU	5		*5*
Recommender Systems	2	VU	3		*3*
Information Search and Retrieval	3	VU	5	*5*	
Social Media Technologies	2	VU	3		*3*
Evaluation Methodology	2	VU	3	*3*	
Critical Readings in Data Science 1	2	UE	4	*4*	
Critical Readings in Data Science 2	2	UE	4		*4*

Elective Module B6: Data Science – Statistics					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Industrial Statistics	3	VO	4		*4*
Industrial Statistics	1	UE	2		*2*
Statistics	3	VO	4.5	*4.5*	
Statistics	1	UE	1.5	*1.5*	
Topological Data Analysis	3	VU	5		*5*

Elective Module B7: Data Science – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Data Science	4	SP	10	*10*	*10*
Seminar Data Science	3	SE	5	*5*	*5*

[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(3) Course Catalogue for Elective Module Group C: Games Engineering

Elective Module C3: Games Engineering – Algorithms and Software Technologies					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Algorithms and Games[e]	1.5	VU	2	*2*	
Advanced Topics in Artificial Intelligence	2	VO	3	*3*	
Advanced Topics in Artificial Intelligence	1	UE	2	*2*	
Mobile Applications	3	VU	5		*5*
GPU Programming	3	VU	5		*5*
Software Technology	3	VU	5		*5*

Elective Module C4: Games Engineering – Human Computer Interaction					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Designing Interactive Systems	2	VU	3		*3*
HCI: Applying User-Centred Design	3	VU	4.5		*4.5*
Information Architecture and Web Usability	3	VU	5	*5*	
Social Media Technologies	2	VU	3		*3*
User Interfaces	1.5	VU	2		*2*
Intelligent User Interfaces	3	VU	5		*5*
Evaluation Methodology	2	VU	3	*3*	

Elective Module C5: Games Engineering – Visual Computing and Virtual Experiences					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Augmented Reality	3	VU	5	*5*	
Virtual Reality	4	VU	7		*7*
3D Computer Graphics and Realism	3	VU	5	*5*	
Geometric 3D-Modelling in Computer Graphics	3	VU	5		*5*
Mathematical Principles in Visual Computing	3	VU	5		*5*

Elective Module C6: Games Engineering – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Games Engineering	4	SP	10	*10*	*10*
Application of Innovative Technologies	2	SE	5	*5*	*5*
Instructional Design in (Game-Based) Learning	2	SE	3		*3*
Mobile Game Engineering	3	SE	5		*5*

[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(4) Course Catalogue for Elective Module Group D: Information Security

Elective Module D3: Information Security – Cryptology & Privacy					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Cryptanalysis	2	VO	3		*3*
Cryptanalysis	1	KU	2		*2*
Privacy Enhancing Technologies	2	VO	3	*3*	
Privacy Enhancing Technologies	1	KU	2	*2*	
Problem Analysis and Complexity Theory	3	VU	4.5		*4.5*
Coding and Cryptography	3	VO	4.5		*4.5*
Coding and Cryptography	1	UE	1.5		*1.5*
Cryptography on Hardware Platforms	3	VU	5	*5*	
Introduction to Quantum Computing	2	VO	3	*3*	

Elective Module D4: Information Security – System Security					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Digital System Integration and Programming	3	VU	5	*5*	
Side-Channel Security	3	VU	5		*5*
Digital System Design	2	VO	3		*3*
Digital System Design	1	KU	2		*2*
Cloud Operating Systems	3	VU	5		*5*
Compiler Construction	2	VO	3		*3*
Compiler Construction	1	KU	2		*2*

Elective Module D5: Information Security – Formal Methods for Security					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Model Checking	2	VO	3		*3*
Model Checking	1	UE	2		*2*
Model-Based Testing	3	VU	5	*5*	
Formal Specification and Design of Software	3	VU	5	*5*	
Logic and Computability[e]	2	VO	3	*3*	
Logic and Computability[e]	1	KU	1	*1*	
Discrete Stochastics and Information Theory (Computer Science)	3	VO	4.5		*4.5*
Discrete Stochastics and Information Theory	1	UE	1		*1*

Elective Module D6: Information Security – Secure Applications					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Mobile Security	2	VO	3		*3*
Mobile Security	1	KU	2		*2*
Secure Product Lifecycle	2	VO	3	*3*	
Secure Product Lifecycle	1	KU	2	*2*	
Einführung in das IT-Recht[DE]	2	VO	3	*3*	
Fault-Tolerant Distributed Algorithms	2	VU	3	*3*	
Knowledge Discovery & Data Mining 1	2	VO	3		*3*
Knowledge Discovery & Data Mining 1	1	KU	1.5		*1.5*

Elective Module D7: Information Security – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Information Security	4	SP	10	*10*	*10*
Seminar Cryptology and Privacy	2	SE	3.5	*3.5*	*3.5*
Seminar Formal Methods	2	SE	3.5	*3.5*	

[DE]: This course is offered in German only.
[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(5) Course Catalogue for Elective Module Group E: Intelligent Systems

Elective Module E3: Intelligent Systems – Artificial Intelligence					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Grundlagen der Artificial Intelligence und Logik [e,DE]	2	VU	3		*3*
Advanced Topics in Artificial Intelligence	2	VO	3	*3*	
Advanced Topics in Artificial Intelligence	1	UE	2	*2*	
Configuration Systems	2	VU	3	*3*	
Logic-Based Knowledge Representation	3	VU	4.5	*4.5*	
Explanations in Artificial Intelligence	2	VU	3		*3*

Elective Module E4: Intelligent Systems – Data Mining and Machine Learning					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Knowledge Discovery & Data Mining 2	3	VU	5	*5*	
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Deep Learning	2	VO	3	*3*	
Deep Learning	1	KU	2	*2*	
Principles of Brain Computation	2	VO	3		*3*
Principles of Brain Computation	1	KU	2		*2*
Adaptive Systems	2	VO	3	*3*	
Adaptive Systems	1	UE	2	*2*	
Data Analysis and Introduction to R	2	VO	3	*3*	
Data Analysis and Introduction to R	1	UE	2	*2*	

Elective Module E5: Intelligent Systems – Robotics					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Advanced Robotics	2	VO	3		*3*
Advanced Robotics	1	LU	2		*2*
Context-Aware Computing	2	VO	3	*3*	
Context-Aware Computing	1	UE	1.5	*1.5*	
Mobile Robots	2	VO	3	*3*	
Mobile Robots	1	UE	2	*2*	
Navigation Systems	2	VU	3	*3*	

Elective Module E6: Intelligent Systems – Software Technology					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Softwareentwicklungsprozess [e,DE]	1	VO	1.5		*1.5*
Object-Oriented Analysis and Design	2	VU	3		*3*
Recommender Systems	2	VU	3		*3*
Mobile Computing, Laboratory	2	LU	3		*3*
Advanced Information Retrieval	3	VU	5	*5*	

Elective Module E7: Intelligent Systems – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Intelligent Systems	4	SP	10	*10*	*10*
Construction of Mobile Robots	2	PT	5	*5*	
Seminar Intelligent Systems	3	SE	5		*5*
Seminar Software Technology	2	SE	3	*3*	
Software Technology Tools	2	SE	3		*3*
Computational Intelligence Seminar A	2	SE	3.5	*3.5*	
Computational Intelligence Seminar B	2	SE	3.5		*3.5*
Seminar Probabilistic Machine Learning	2	SE	3.5		*3.5*

[DE]: This course is offered in German only.
[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(6) Course Catalogue for Elective Module Group F: Interactive and Visual Information Systems

Elective Module F3: Interactive and Visual Information Systems – Mobile and Web Applications					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Mobile Applications	3	VU	5		*5*
Information Architecture and Web Usability	3	VU	5	*5*	
HCI: Applying User-Centred Design	3	VU	4.5		*4.5*
Information Visualisation	3	VU	5		*5*
User Interfaces	1.5	VU	2		*2*
Wearable Computing	3	VU	5		*5*

Elective Module F4: Interactive and Visual Information Systems – Data Mining and Artificial Intelligence					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Knowledge Discovery & Data Mining 1	2	VO	3		*3*
Knowledge Discovery & Data Mining 1	1	KU	1.5		*1.5*
Architecture of Machine Learning Systems	3	VU	5		*5*
Visual Analytics	3	VU	5		*5*
Social Media Technology	2	VU	3		*3*
Intelligent Systems	2	VO	3		*3*
Intelligent Systems	1	KU	2		*2*
3D Object Retrieval	3	VU	5		*5*
Intelligent User Interfaces	3	VU	5		*5*

Elective Module F5: Interactive and Visual Information Systems – Computer Games					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Game Design and Development	3	VU	5	*5*	
Simulation and Animation	3	VU	5		*5*
Visualisation	3	VU	5	*5*	

Elective Module F6: Interactive and Visual Information Systems – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Interactive and Visual Information Systems	4	SP	10	*10*	*10*
Seminar Interactive and Visual Information Systems	3	SE	5	*5*	*5*
Instructional Design in (Game-Based) Learning	2	SE	3		*3*
Application of Innovative Technologies	2	SE	5	*5*	*5*

(7) Course Catalogue for Elective Module Group G: Machine Learning

Elective Module G3: Machine Learning – Learning Architectures					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Principles of Brain Computation	2	VO	3		*3*
Principles of Brain Computation	1	KU	2		*2*
Architecture of Machine Learning Systems	3	VU	5		*5*

Elective Module G4: Machine Learning – Signal Processing					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Adaptive Systems	2	VO	3	*3*	
Adaptive Systems	1	UE	2	*2*	
Linguistic Foundations of Speech and Language Technology	2	VO	3	*3*	
Automatic Speech Recognition	2	VO	3	*3*	
Signal Processing	2	VO	3		*3*

Elective Module G4: Machine Learning – Signal Processing

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Signal Processing	1	UE	2		*2*
Spoken Language in Human and Human-Computer Dialogue	2	VU	3		*3*
Nonlinear Signal Processing	2	VO	3		*3*
Nonlinear Signal Processing	1	UE	2		*2*
Speech Synthesis	2	VU	3	*3*	
Advanced Information Theory	2	VU	3		*3*

Elective Module G5: Machine Learning – Optimisation

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Nonlinear Optimization[e]	3	VO	4.5	*4.5*	
Nonlinear Optimization[e]	2	UE	2.5	*2.5*	
Convex Optimization	3	VU	5		*5*

Elective Module G6: Machine Learning – Statistics and Data Mining

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Statistics	3	VO	4.5	*4.5*	
Statistics	1	UE	1.5	*1.5*	
Recommender Systems	2	VU	3		*3*
Knowledge Discovery & Data Mining 1	2	VO	3		*3*
Knowledge Discovery & Data Mining 1	1	KU	1.5		*1.5*
Knowledge Discovery & Data Mining 2	3	VU	5	*5*	
Natural Language Processing	3	VU	5		*5*
Information Search and Retrieval	3	VU	5	*5*	
Network Science	3	VU	5	*5*	
Explanations in Artificial Intelligence	2	VU	3		*3*

Elective Module G7: Machine Learning – Projects and Seminars

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Machine Learning	4	SP	10	*10*	*10*
Computational Intelligence Seminar A	2	SE	3.5	*3.5*	
Computational Intelligence Seminar B	2	SE	3.5		*3.5*
Signal Processing and Machine Learning 1	2	SE	3.5	*3.5*	
Signal Processing and Machine Learning 2	2	SE	3.5		*3.5*

[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(8) Course Catalogue for Elective Module Group H: Robotics

Elective Module H3: Robotics – Foundations of Robotics					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Context-Aware Computing	2	VO	3	*3*	
Context-Aware Computing	1	UE	1.5	*1.5*	
Kinematics and Robotics	2	VO	3		*3*
Kinematics and Robotics	1	KU	2		*2*
Navigation Systems	2	VU	3	*3*	
Inertial Navigation	2	VO	3		*3*
Inertial Navigation	1	KU	1.5		*1.5*
Industrieroboter[DE]	2	VO	3	*3*	
Laborübung Industrieroboter[DE]	3	LU	3	*3*	
Wearable Computing	3	VU	5		*5*

Elective Module H4: Robotics – Data Mining and Machine Learning					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Deep Learning	2	VO	3	*3*	
Deep Learning	1	KU	2	*2*	
Reinforcement Learning	2	VO	3	*3*	
Reinforcement Learning	1	KU	2	*2*	
Knowledge Discovery & Data Mining 1	2	VO	3		*3*
Knowledge Discovery & Data Mining 1	1	KU	1.5		*1.5*
Natural Language Processing	3	VU	5		*5*
Nonlinear Optimization	3	VO	4.5	*4.5*	
Nonlinear Optimization	2	UE	2.5	*2.5*	
Convex Optimization	3	VU	5		*5*
Automatic Speech Recognition	2	VO	3	*3*	
Intelligent User Interfaces	3	VU	5		*5*
Spoken Language in Human and Human-Computer Dialogue	2	VU	3		*3*

Elective Module H5: Robotics – Artificial Intelligence					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Grundlagen der Artificial Intelligence und Logik[e,DE]	2	VU	3		*3*
Advanced Topics in Artificial Intelligence	2	VO	3	*3*	
Advanced Topics in Artificial Intelligence	1	UE	2	*2*	
Logic-Based Knowledge Representation	3	VU	4.5	*4.5*	

Elective Module H6: Robotics – Computer Vision					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Camera Drones	3	VU	5	*5*	
Image Based Measurement	2	VO	3	*3*	
Image Based Measurement, Laboratory	1	LU	2	*2*	

Elective Module H7: Robotics – Software Engineering					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Software Engineering for Autonomous Robots	2	VU	3	*3*	
Designing Interactive Systems	2	VU	3		*3*
Design Thinking and Rapid Prototyping	3	LU	3		*3*
Modelling Technical Systems	2	VO	3		*3*
Modelling Technical Systems	1	KU	2		*2*
Embedded Systems	2	VO	3		*3*
Embedded Systems, Laboratory	1	LU	2		*2*

Elective Module H8: Robotics – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Robotics	4	SP	10	*10*	*10*
Construction of Mobile Robots	2	PT	5	*5*	
Seminar Robotics	2	SE	3	*3*	

DE: This course is offered in German only.
e: Recommended course, unless it was already completed in the bachelor's degree programme.

(9) Course Catalogue for Elective Module Group I: Software Technology

Elective Module I3: Software Technology – Artificial Intelligence and Theoretical Computer Science					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Advanced Topics in Artificial Intelligence	2	VO	3	*3*	
Advanced Topics in Artificial Intelligence	1	UE	2	*2*	
Configuration Systems	2	VU	3	*3*	
Intelligent Systems	2	VO	3		*3*
Intelligent Systems	1	KU	2		*2*
Problem Analysis and Complexity Theory	3	VU	4.5		*4.5*
Recommender Systems	2	VU	3		*3*
Logic-Based Knowledge Representation	3	VU	4.5	*4.5*	

Elective Module I4: Software Technology – Modelling and Formal Methods					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Model Checking	2	VO	3		*3*
Model Checking	1	UE	2		*2*
Formal Specification and Design of Software	3	VU	5	*5*	
Modelling Technical Systems	2	VO	3		*3*
Modelling Technical Systems	1	KU	2		*2*
Model-Based Testing	3	VU	5	*5*	

Elective Module I5: Software Technology – Software Design and Architecture					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Designing Interactive Systems	2	VU	3		*3*

Elective Module I5: Software Technology – Software Design and Architecture

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Architecture of Database Systems	3	VU	5	*5*	
Architecture of Machine Learning Systems	3	VU	5		*5*
Advanced Information Retrieval	3	VU	5	*5*	
Information Architecture and Web Usability	3	VU	5	*5*	

Elective Module I6: Software Technology – Software Engineering

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Mobile Applications	3	VU	5		*5*
Software Engineering for Autonomous Robots	2	VU	3	*3*	
Design Thinking and Rapid Prototyping	3	LU	3		*3*
Agile Software Development	3	VU	5		*5*
Object-Oriented Analysis and Design	2	VU	3		*3*
Software Maintenance	3	VU	4.5		*4.5*
Qualitätssicherung in der Softwareentwicklung[e,DE]	2	VU	2.5		*2.5*
Industrial Software Development and Quality Management	2	VO	3		*3*
Industrial Software Development and Quality Management	1	UE	2		*2*

Elective Module I7: Software Technology – Safe and Secure Systems

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Secure Software Development	2	VO	3	*3*	
Secure Software Development	1	UE	2	*2*	
Secure Application Design	2	VO	3		*3*
Secure Application Design	1	KU	2		*2*
Software Testing for Safety-Critical Systems	2	VO	3	*3*	
Software Testing for Safety-Critical Systems	1	KU	2	*2*	
Advanced Topics in Software Testing	2	VO	3		*3*
Advanced Topics in Software Testing	1	KU	2		*2*

Elective Module I8: Software Technology – Projects and Seminars

Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Software Technology	4	SP	10	*10*	*10*
Seminar Software Technology	2	SE	3	*3*	
Software Technology Tools	2	SE	3		*3*

[DE]: This course is offered in German only.
[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(10) Course Catalogue for Elective Module Group J: Visual Computing

Elective Module J3: Visual Computing – Foundations of Visual Computing

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Nonlinear Optimization[e]	3	VO	4.5	*4.5*	
Nonlinear Optimization[e]	2	UE	2.5	*2.5*	
Convex Optimization	3	VU	5		*5*
Machine Learning 1[e]	2	VO	3		*3*
Machine Learning 1[e]	1	UE	1.5		*1.5*
Machine Learning 2	2	VO	3		*3*
Machine Learning 2	1	KU	2		*2*
Mathematical Principles in Visual Computing	3	VU	5		*5*
Geometry for Computer Scientists	2	VU	3	*3*	

Elective Module J4: Visual Computing – Computer Graphics

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
3D Computer Graphics and Realism	3	VU	5	*5*	
GPU Programming	3	VU	5		*5*
Discrete Differential Geometry	2	VO	3		*3*
Fundamentals of Geometry Processing[e]	3	VU	4.5		*4.5*

Elective Module J5: Visual Computing – Computer Vision

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Camera Drones	3	VU	5	*5*	
Image and Video Understanding	2	VO	3	*3*	
Image and Video Understanding	1	KU	2	*2*	
Image Based Measurement	2	VO	3	*3*	
Image Based Measurement, Laboratory	1	LU	2	*2*	
Medical Image Analysis	2	VO	3		*3*
Medical Image Analysis	1	KU	2		*2*

Elective Module J6: Visual Computing – Visualisation and Virtual Reality

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Virtual Reality	4	VU	7		*7*
Simulation and Animation	3	VU	5		*5*
Visualisation	3	VU	5	*5*	
Information Visualisation	3	VU	5		*5*
Augmented Reality	3	VU	5	*5*	
Computer Aided Geometric Design	3	VU	5	*5*	
3D Object Retrieval	3	VU	5		*5*

Elective Module J7: Visual Computing – Projects and Seminars

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar/Project Visual Computing	4	SP	10	*10*	*10*
Seminar Visual Computing	3	SE	5		*5*

Elective Module J7: Visual Computing – Projects and Seminars					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Seminar Pattern Recognition	3	SE	5	*5*	

[e]: Recommended course, unless it was already completed in the bachelor's degree programme.

(11) Course Catalogue for Elective Module Group Business

Elective Module K2: Business Informatics					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Business Modelling and Simulation	2	VO	2	*2*	
Business Modelling and Simulation	2	UE	2	*2*	
Information Management	3	VU	4	*4*	
Optimization Methods for Operations Planning	3	VU	3		*3*
Production Planning & Control	2	VO	3	*3*	
Production Planning & Control	2	UE	3	*3*	
Selected Topics of Business Informatics	2	VO	2	*2*	
Selected Topics of Business Informatics	1	UE	1	*1*	
Selected Topics of Business Informatics	2	SE	2		*2*
Modelling and Optimization in Production and Logistic Systems	2	VU	2		*2*
Technology Management	2	VO	3		*3*
Praxis der Digitalen Transformation[DE]	1	VO	1		*1*
Praxis der Digitalen Transformation[DE]	1	UE	1		*1*

Elective Module L2: Industrial Management and Innovation					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Creativity Techniques	2	VU	2	*2*	*2*
Design to Value	4	VU	4		*4*
Implementing Innovation Strategy through Merger and Acquisition	2	SE	2	*2*	
Industrial Energy Management	1	VO	1.5		*1.5*
Industrial Energy Management	1	UE	1		*1*
Industrial Engineering	2	VO	3	*3*	
Industrial Engineering	1	UE	1	*1*	
Selected Topics of Industrial Engineering	2	VU	2		*2*
Industrial Management Seminar	2	SE	2	*2*	
LEAD Factory	3	LU	3	*3*	*3*
Factory Planning and Design	2	VU	2		*2*
Product Innovation	3	PT	3	*3*	
Product Innovation 2	2	PT	2		*2*
Value Engineering	3	VU	3	*3*	
Master Project Industrial Management and Innovation	1	PT	10		*10*
Design Thinking & Rapid Prototyping	3	LU	3		*3*
Selected Topics of Innovation Management	2	VU	2	*2*	
Production Strategies	2	SE	2	*2*	

Elective Module M2: Management and Strategy

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Business Model Management	2	SE	2		*2*
Change Management	1	VO	1		*1*
Change Management	1	UE	2		*2*
Entrepreneurship	2	VO	3		*3*
Entrepreneurship	1	UE	1		*1*
General Management, Case Studies	3	SE	3		*3*
Marketing Intelligence	1	SE	1		*1*
Marketing Management	3	SE	3		*3*
Selected Topics in Management	3	SE	3	*3*	
Strategic Management	2	VO	3		*3*
Technology Management	2	VO	3	*3*	
Gründungsgarage[DE]	2	SE	2	*2*	*2*
Praxis der Digitalen Transformation[DE]	1	VO	1		*1*
Praxis der Digitalen Transformation[DE]	1	UE	1		*1*
Prozessmanagement[DE]	4	SE	4		*4*
MOOC Start-up-Journey: Geschäftsmodell erstellen[DE]	1	SE	1	*1*	*1*

Elective Module N2: Management Control, Accounting and Finance

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Business Valuation	3	SE	3		*3*
Entrepreneurship	2	VO	3		*3*
Entrepreneurship	1	UE	1		*1*
General Management, Case Studies	3	SE	3		*3*
International Accounting Standards	2	SE	2		*2*
Marketing Intelligence	1	SE	1		*1*
Marketing Management	3	SE	3		*3*
Purchasing and Supply Management	3	VO	4.5	*4.5*	
Research Design in Management Science	2	SE	2	*2*	
Rhetoric and Presentation	2	SE	2	*2*	
Technology Management	2	VO	3	*3*	
AK Controlling[DE]	4	SE	4	*4*	
Arbeitsrecht[DE]	2	VO	3	*3*	
Patentrecht[DE]	2	VO	3	*3*	
Unternehmens- und Jahresabschlussanalyse[DE]	2	SE	2		*2*
Business Economics Lab	3	LU	3	*3*	

[DE]: This course is offered in German only.

(12) Course Catalogue for Elective Module Group Route-63

The courses in module groups O1 to R1 are mainly offered at the University of Graz in the framework of the [2]*Route-63 Initiative*. In order to complete these courses, co-registration at the University of Graz is required. Courses offered at the University of Graz (KFU) are marked with the superscript letters[KFU].

Elective Module O2: Digital Entrepreneurship

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Entrepreneurship	1	UE	2		*2*
Introduction to International Entrepreneurship	3	VU	5	*5*	*5*
Marketing Management	3	SE	3		*3*
Marketing Intelligence	1	SE	1		*1*
Introductory Marketing Research[KFU]	2	KS	4	*4*	*4*
Research Design in Management Science	2	SE	2	*2*	
Advanced Marketing Research[KFU]	2	KS	4	*4*	*4*
Introduction to Buyer Behaviour[KFU, DE]	2	KS	4	*4*	*4*
Advanced Topics in Buyer Behaviour[KFU, DE]	2	KS	4	*4*	*4*
Empirische Wirtschaftsforschung 1 (Marketing Research)[KFU, DE]	2	PS	4		*4*
Empirische Wirtschaftsforschung 2 (Marketing Research)[KFU, DE]	2	PS	4		*4*
Customer Relationship Management[KFU, DE]	2	PS	4	*4*	
Services Management[KFU, DE]	2	PS	4	*4*	
Sales Management[KFU]	2	PS	4		*4*
Business-to-Business Management[KFU]	2	PS	4	*4*	
Business Model Management	2	SE	2		*2*
MOOC Start-up-Journey: Geschäftsmodell erstellen [DE]	1	SE	1		*1.5*
Elektronische Geschäftsmodelle und digitale Ökonomie[KFU, DE]	2	PS	4	*4*	*4*
Organisatorische Gestaltung 1[KFU, DE]	2	KS	4	*4*	
Einführung in das IT-Recht[KFU, DE]	2	VO	3	*3*	*3*
Introduction to Intercultural Marketing	3	VU	5		*5*

Elective Module P2: Cognition and Behaviour

Course	Course			Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Wissenschaftliches Arbeiten: Forschungsmethoden[KFU, DE]	2	VO	4		*4*
Messtheorie[KFU, DE]	2	VO	4	*4*	
Sozialpsychologie (I)[KFU, DE]	2	VO	3	*3*	
Entwicklungspsychologie (I)[KFU, DE]	2	VO	3	*3*	
Differentielle Psychologie I[KFU, DE]	2	VO	3		*3*
Methods of Functional Brain Research	2	VO	3		*3*
Cognitive Neuroscience	2	VO	3	*3*	
Vertiefung Testkonstruktion[KFU, DE]	2	VU	3		*3*
Forschungsmethoden der kognitiven und affektiven Neurowissenschaften[KFU, DE]	2	VO	3		*3*
Gebundenes Wahlfach Grundlagenvertiefung	2	SE	4	*4*	

[2] https://www.tugraz.at/fakultaeten/infbio/studies/route-63

Elective Module P2: Cognition and Behaviour

Course	SSt	Course Type	ECTS	Semester allocation WS	SS
(Entscheidungsforschung)[KFU, DE]					
Human Factors: Arbeitstätigkeit im MTO-Kontext[KFU, DE]	2	SE	4	*4*	
Human Factors: Faktor Mensch und Systemsicherheit [KFU]	2	SE	4		*4*
Vertiefung Intervention[KFU, DE]	2	SE	4	*4*	*4*
Interventionsmethoden/Prävention: Rehabilitation nach neurologischen Schädigungen[KFU, DE]	2	SE	4		*4*

Elective Module Q2: Current Societies

Course	SSt	Course Type	ECTS	Semester allocation WS	SS
Methods of Empirical Social Research[KFU]	2	KS	5	*5*	*5*
Elementare Datenanalyse mit EDV[KFU, DE]	3	KS	5	*5*	*5*
Qualitative Sozialforschung[KFU, DE]	2	KS	4	*4*	*4*
Multivariate Datenanalyse[KFU, DE]	2	KS	4	*4*	*4*
Fortgeschrittene Methoden der Datenanalyse[KFU, DE]	2	KS	6	*6*	*6*
Fortgeschrittene qualitative Methoden[KFU, DE]	2	KS	6	*6*	*6*
Soziologische Theorie II[KFU, DE]	2	SE	5	*5*	*5*
Organisationen und Institutionen (Einführung in die Mesosoziologie)[KFU, DE]	2	KS	4	*4*	*4*
Gesellschaft, Kultur, sozialer Wandel (Einführung in die Makrosoziologie)[KFU, DE]	2	KS	4	*4*	*4*
Wirtschaft und Gesellschaft: Einführung in die Wirtschaftssoziologie[KFU, DE]	2	VU	4	*4*	
Social Media Technologies	2	VU	3		*3*
Evaluation Methodology	2	VU	3	*3*	
Felder soziologischer Forschung: Wissenschafts- und Techniksoziologie[KFU, DE]	2	SE	6	*6*	
Computational Modelling of Social Systems	3	VU	4.5		*4.5*
Computational Social Choice	2	VU	3		*3*
Network Science	3	VU	5	*5*	

Elective Module R2: Business Law

Course	SSt	Course Type	ECTS	Semester allocation WS	SS
Gewerberecht[KFU, DE]	2	VU	3	*3*	
Umwelt- und Anlagenrecht[KFU, DE]	2	VO	3	*3*	
Grundlagen des Unternehmensrechts[KFU, DE]	2	VO	3	*3*	
Rechtsformwahl für unternehmerische Tätigkeit[KFU, DE]	1	VU	1.5	*1.5*	
Gesellschaftsrecht[KFU, DE]	2	KS	5	*5*	
Rechtliches Projektmanagement[KFU, DE]	2	KS	5	*5*	
Vertragsgestaltung[KFU, DE]	2	KS	5	*5*	
Legal English for Technicians[KFU, DE]	1	KS	2.5	*2.5*	
Internationale Vertragspraxis in englischer Sprache[KFU, DE]	2	KS	5	*5*	
Normung und technisches Sicherheitsrecht[KFU, DE]	2	VO	5		*5*
Vergaberecht[KFU, DE]	2	KS	5		*5*
Insolvenz- und Sanierungsrecht[KFU, DE]	2	VU	3		*3*
Wirtschaftsstrafrecht[KFU, DE]	2	VU	3		*3*
Kreditsicherheiten[KFU, DE]	2	KS	5		*5*

Elective Module R2: Business Law					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Grundlagen des geistigen Eigentums[KFU, DE]	1	VO	1.5	*1.5*	
Erwerb und Sicherung des geistigen Eigentums[KFU, DE]	2	KS	5	*5*	
Verwertung des geistigen Eigentums[KFU, DE]	2	KS	5	*5*	

[DE]: This course is offered in German only.
[KFU]: This course is offered at the University of Graz.

(13) Course Catalogue for Elective Module Science, Technology and Society

Elective Module S: Science, Technology and Society					
Course		Course		Semester allocation	
	SSt	**Type**	**ECTS**	**WS**	**SS**
Science, Technology and Society: Core Concepts and Case Studies	2	VO	4	*4*	
Technik – Ethik – Politik[DE]	2	VU	4		*4*
Technikfolgenabschätzung[DE]	2	SE	4	*4*	*4*
Technik und Geschlecht I[DE]	2	SE	4	*4*	
Future Studies I: Foundations and methods	2	VU	4	*4*	
Future Studies II: Theories and uses	2	VU	4		*4*
Utopia and Dystopia of Technology	2	SE	4	*4*	
Self-Optimisation and Digitalisation of the Body	2	SE	4		*4*
Technikgeschichte[DE]	2	VU	4		*4*
Special Topics in STS – Science, Technology and Society	2	SE	4	*4*	*4*
Vielfalt im Zentrum der Forschung[DE]	2	SE	3		3

[DE]: This course is offered in German only.

Students may also take courses to deepen their knowledge of a foreign language with a total scope of up to 3 ECTS credit points for a minor.

Courses with the title “Selected Topics of [module group name] (subtitle)” are assigned to the corresponding module groups, whereby one semester course hour usually corresponds to 1.5 ECTS credit points. These courses have descriptive subtitles and are offered with a total scope of 1–3 semester course hours for lectures (VO) and/or 1-2 semester course hours for exercises (UE) or 2–3 semester course hours for lectures with integrated exercises (VU). Courses with different subtitles should be evaluated as different courses.

§ 10 Free-choice subjects

(1) The courses to be completed as part of the free-choice courses in the Master's Degree Programme Software Engineering and Management are designed to provide individual strategic focus and further development of the students. They may be freely selected from the courses offered by any recognised national or international universities and also recognised national or international post-secondary

educational institutions. Appendix II contains a recommendation for free-choice courses.

(2) If a free-choice course does not have an allocation of ECTS credit points, each semester course hour (SSt.) of this course is counted as one ECTS credit. However, if such courses are lecture-type courses (VO), they are assigned 1.5 ECTS credit points for each semester course hour.

§ 11 Master's thesis

(1) The master's thesis serves to demonstrate that the student is able to work on topics in their subject independently and competently both in terms of the subject matter and in terms of methodology. The scope of the master's thesis must be determined in such a way that its completion can be reasonably and feasibly be accomplished by the student within a period of six months.

(2) The subject of the master's thesis is to be assigned to the major or the minor. However, the thesis may only be assigned to the minor if the minor has been selected from the module groups K-N. The officers responsible for study matters decide on exceptions.

(3) The master's thesis must be registered before beginning work on it via the Dean's office with consultation of the competent officer for study matters. The details that should be registered are the topic, the subject that the topic belongs to and the supervisor, stating their institute.

(4) 30 ECTS credit points are allocated to the master's thesis.

(5) The master's thesis must be submitted for assessment in both printed and electronic form.

§ 12 Registration requirements for courses/examinations

Admission to the master's degree examination before a committee requires proof of the positive assessment of all examination results according to § 8 to § 10 above and also proof of the positive assessment of the master's thesis.

§ 13 Stays abroad

(1) Recommended stays abroad

It is recommended for students to spend one semester abroad in the course of their studies. In this master's degree programme, the 2nd or 3rd semesters are particularly suitable for this purpose.

Furthermore, upon application to the officers responsible for study matters, achievements from shorter study stays abroad, such as active participation in international summer or winter schools, may also be recognised with up to 3 ECTS credit points within the framework of free-choice courses.

IV Examination Regulations and Completion of Studies

§ 14 Examination regulations

Courses are assessed individually.

(1) Examinations for courses held as lectures (VO) cover the complete content of the course. Examinations can be oral-only, written-only or a combination of oral and written.

(2) In courses of the types lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), design exercises (KU), field exercises (FU), projects (PT), seminars (SE), seminar projects (SP) and excursions (EX), students' performance is measured by continuous assessment of work done by the students and/or by ongoing tests. The assessment must be based on at least two evaluations of different aspects of the course.

(3) If a module/a module group is made up of multiple examination results, the overall grade for the module/module group is to be calculated as follows:

a. The grade of each examination belonging to the module/module group is multiplied by the ECTS credit points for the corresponding course.

b. The numbers calculated in point (a) are added together,

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. Values after the decimal point that are larger than 0.5 are rounded up and values that are less than 0.5 are rounded down.

e. A positive grade for the module/module group can only be awarded if the grades for each individual examination were all positive.

f. Courses whose assessment consists only of "successful/unsuccessful participation" are not included in the calculation under points a to d.

(4) Regulations on the repetition of partial performances in courses with continuous assessment are laid down in the Excerpt of Statutes: Legal Regulations for Academic Affairs of TU Graz.

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

- the presentation of the master's thesis (max. 25 minutes), and
- the defence of the master's thesis (examination interview).

(6) The total duration of the master's examination before a committee is usually 60 minutes and must not exceed 75 minutes.

(7) The examination committee consists of the master's thesis supervisor and two other members who are nominated by officers responsible for study matters after hearing the candidate. The committee must be chaired by one of the members who is not the supervisor of the thesis.

(8) The grade of this master's examination before a committee is determined by the examination committee on the basis of the performance delivered during the master's examination.

§ 15 Completion of studies

(1) With the positive assessment of the courses of all compulsory and elective modules, the free-choice subjects, the master's thesis and the master's examination before a committee, the master's degree programme is deemed to be completed.

(2) A degree certificate must be issued upon successful completion of the degree programme. The degree certificate for the Master's Degree Programme Software Engineering and Management contains:

a. the major according to § 4 (including ECTS credit points) and its assessment,
b. the minor incl. elective subject according to § 4 (including ECTS credit points) and their assessment,
c. the title and the assessment of the master's thesis,
d. the grade of the master's examination before the committee,
e. the total of the ECTS credit points of the elective courses as defined in § 10, and
f. the overall grade in accordance with § 11 of the Excerpt of Statutes: Legal Regulations for Academic Affairs of TU Graz.

V Entry into Force and Transitional Regulations

§ 16 Entry into force

This curriculum 2020 in the version of 2024 enters into force on 1 October 2024.

Version of the curriculum:

Curriculum	Version	published in the TU Graz University Gazette
2020	2020	15 June 2020, issue 17a
2020	2022	18 March 2022, issue 12a
2020	2024	29 May 2024, issue 16a

§ 17 Transitional regulations

Students of the Master's Degree Programme Software Engineering and Management who are subject to the curriculum in the version from 2020 at the time when these changes to the curriculum come into force on 1 October 2024, will be subject to the 2024 version of the curriculum as of 1 October 2024.

Appendices to the Curriculum of the Master's Degree Programme Software Engineering and Management

Appendix I. Module Descriptions and Assessment Methods

The examination of performance in modules is carried out by completing the intended ECTS credit points according to § 4.

Module Group Algorithms and Theoretical Computer Science:

Compulsory Module A1	**Algorithms and Theoretical Computer Science – Compulsory 1**
ECTS credit points:	9
Content:	This module covers the basics of higher probability theory and information theory and also algorithms and methods for counting up and down.
Learning outcomes:	Upon completion of the module, students have developed an understanding of the basics of probability theory, information theory and methods and algorithms for counting up and down.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Knowledge of probability calculation. Measure theory is an advantage. Basic mathematics (graph theory, combinatorics) and knowledge of algorithms. About the same level as the course in “Design and Analysis of Algorithms.”
Frequency in which the module is provided:	Every academic year

Compulsory Module A2	**Algorithms and Theoretical Computer Science – Compulsory 2**
ECTS credit points:	13.5
Content:	This module covers structures of combinatorial, discrete and computational geometry and classical problems of combinatorial optimisation with emphasis on polynomially solvable problems. Furthermore, central techniques for dealing with NP-hard problems are presented.
Learning outcomes:	After the successful completion of this module, students are familiar with the most important problems and algorithmic solution approaches of combinatorial optimisation and have in-depth knowledge of discrete geometric structures, methods for their analysis, and also efficient computer procedures for their processing.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE
Prerequisites for participation:	Basic mathematical (Linear Algebra 1, Discrete Mathematics, Analysis 1) and algorithmic knowledge, e.g. asymptotic notations and simple algorithmic design principles.
Frequency in which the module is provided:	Every academic year

Elective Module A3	Algorithms and Theoretical Computer Science – Algorithms
ECTS credit points:	max. 25
Content:	This module covers algorithms in various contexts such as graph theory, optimisation and game theory. Furthermore, it deals with methods for the analysis of combinatorial problems and complexity theory issues.
Learning outcomes:	Upon completion of the module, students are able to expand and deepen their knowledge in the areas of “Algorithms and Data Structures”. They are able to design and analyse algorithms independently and to solve problems of geometry, graph theory, combinatorics and optimisation algorithmically.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic mathematical knowledge and also algorithmic knowledge of data structures and algorithms; basic programming skills.
Frequency in which the module is provided:	Every academic year

Elective Module A4	Algorithms and Theoretical Computer Science – Optimisation
ECTS credit points:	max. 24.5
Content:	Optimisation algorithms are central to many areas of computer science. This module provides more in-depth knowledge in optimisation algorithms.
Learning outcomes:	Upon completion of this elective module, students will have a sound basic mathematical and algorithmic knowledge of optimisation methods.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in analysis, linear algebra and algorithms.
Frequency in which the module is provided:	Every academic year

Elective Module A5	Algorithms and Theoretical Computer Science – Theoretical Computer Science
ECTS credit points:	max. 23
Content:	This module provides in-depth knowledge of theoretical problems of computer science, especially in the fields of theoretical computer science, complexity theory, logic and information theory.
Learning outcomes:	Upon completion of this elective module, students will have sound mathematical knowledge of the theoretical foundations of computer science.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU, VU
Prerequisites for participation:	Basic mathematical knowledge.
Frequency in which the module is provided:	Every academic year

Elective Module A6	Algorithms and Theoretical Computer Science – Applications
ECTS credit points:	max. 35.5
Content:	This module covers issues in computer science with strong theoretical and/or algorithmic components and also number theory as a basis for many algorithmic issues.
Learning outcomes:	Upon completion of this elective module, students will have knowledge of various computer science subject areas with pronounced theoretical and/or algorithmic components.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU, VU
Prerequisites for participation:	Basic mathematical and algorithmic knowledge.

Frequency in which the module is provided:	Every academic year

Elective Module A7	**Algorithms and Theoretical Computer Science – Projects and Seminars**
ECTS credit points:	10–15
Content:	Practical and/or theoretical implementation of a specific topic from a subfield of algorithm design and theoretical computer science. Independent review of the relevant literature and derivation of an assignment. Analysis and processing of the problem and drawing the necessary conclusions. Preparation of written contributions and oral presentations. This module also serves as preparation for the master's thesis.
Learning outcomes:	After successful completion of the course, students have developed a deeper understanding of scientific working methods and are able to carry out scientific work with simple assignments independently, and to produce a written paper on them. Students are able to present scientific results orally and discuss them in a group.
Teaching and learning activities and methods:	Independent work under supervision, presentations, discussion in groups.
Prerequisites for participation:	In-depth knowledge of algorithms and/or knowledge in the field of theoretical computer science.
Frequency in which the module is provided:	Every academic year

Module Group Data Science:

Compulsory Module B1	**Data Science – Compulsory 1 (major and minor)**
ECTS credit points:	9.5
Content:	This module provides basic knowledge in data mining and analysis of substantial amounts of data. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation. Thus, this module covers the necessary basics for a further deepening of knowledge in the field of data science.
Learning outcomes:	After completing the subject, students are familiar with the essential basics of data science and are also able to implement these in practical applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, and VU
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics.
Frequency in which the module is provided:	Every academic year

Compulsory Module B2	**Data Science – Compulsory 2 (minor)**
ECTS credit points:	10
Content:	This module teaches the basic architecture of modern machine learning systems and the statistical analysis of substantial amounts of data in the R programming language. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	Upon completion of the module, students are familiar with the essential basics of modern machine learning systems and also statistical data analysis and they are able to implement these in practical applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, and VU
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics.

Frequency in which the module is provided:	Every academic year

Elective Module B3	**Data Science – Data Mining and Machine Learning**
ECTS credit points:	max. 31.5
Content:	This module provides in-depth knowledge in data mining and optimisation, machine learning and neural networks. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	Upon completion of the module, students are familiar with the essential basics and applications of data mining and machine learning and are able to implement these in practical applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, and VU
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics.
Frequency in which the module is provided:	Every academic year

Elective Module B4	**Data Science – Data Management**
ECTS credit points:	max. 13
Content:	This module provides in-depth knowledge in the fields of databases and data management of large data volumes. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	Upon completion of the module, students will be familiar with the essential basics and applications of data management and will be able to implement these in practical applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, and VU
Prerequisites for participation:	Basic knowledge of databases, programming and software development.
Frequency in which the module is provided:	Every academic year

Elective Module B5	**Data Science – Social Data Science**
ECTS credit points:	max. 42
Content:	This module provides in-depth knowledge in the fields of recommender systems, social web, social media and user models and evaluation methodologies of such models. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	Upon completion of the module, students will be familiar with essential basics and applications of social media and recommender systems and will be able to implement them in practical applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE and VU
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics, programming and software development.
Frequency in which the module is provided:	Every academic year

Elective Module B6	**Data Science – Statistics**
ECTS credit points:	max. 17
Content:	This module provides in-depth knowledge of statistics and its application in data science. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	Upon completion of the module, students are familiar with essential basics and applications of statistics in the field of data science and are able to implement them in practical applications.

Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE and VU.
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics.
Frequency in which the module is provided:	Every academic year

Elective Module B7	**Data Science – Projects and Seminars**
ECTS credit points:	10–15
Content:	Practice-oriented implementation of projects in the field of data science within the framework of interactive seminar events.
Learning outcomes:	Consolidation of knowledge in specific topics from the field of data science.
Teaching and learning activities and methods:	Preparation of the subjects within the framework of practice-oriented courses and seminars.
Prerequisites for participation:	Basic knowledge of vector and matrix calculus, elementary differential calculus and probability theory and statistics, programming and software development.
Frequency in which the module is provided:	Every academic year

Module Group Games Engineering:

Compulsory Module C1	**Games Engineering – Compulsory 1**
ECTS credit points:	10
Content:	Basics of game development, game design and real-time graphics
Learning outcomes:	Upon completion of the compulsory module, students understand basic techniques and methods of game development and real-time graphics and have developed a first game prototype.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU
Prerequisites for participation:	Basic knowledge in the fields of software development and computer graphics
Frequency in which the module is provided:	Every academic year

Compulsory Module C2	**Games Engineering – Compulsory 2**
ECTS credit points:	10
Content:	In-depth knowledge of game development, game design, simulation and animation techniques.
Learning outcomes:	Upon completion of this compulsory module, students will have sound knowledge of techniques and methods of game development, and also simulation and animation techniques.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VU
Prerequisites for participation:	Basic knowledge in the fields of software development and computer graphics
Frequency in which the module is provided:	Every academic year

Elective Module C3	**Games Engineering – Algorithms and Software Technologies**
ECTS credit points:	max. 22
Content:	Introduction to the basics of selected chapters relevant for game development such as artificial intelligence, algorithms, mobile applications, GPU programming or software technologies.
Learning outcomes:	Upon completion of this elective module, students will have sound knowledge of selected chapters of game development and basic areas of software development relevant to game development.

Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, VU
Prerequisites for participation:	Basic knowledge of software development and computer graphics, data structures and algorithms
Frequency in which the module is provided:	Every academic year

Elective Module C4	**Games Engineering – Human Computer Interaction**
ECTS credit points:	max. 25.5
Content:	Introduction to the basics of human computer interaction, such as the design and evaluation of user interactions or data analytics in game design.
Learning outcomes:	Upon completion of this elective module, students will have knowledge of the design and also the evaluation and analysis of human-machine interactions.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VU
Prerequisites for participation:	Basic knowledge in the field of software development.
Frequency in which the module is provided:	Every academic year

Elective Module C5	**Games Engineering – Visual Computing and Virtual Experiences**
ECTS credit points:	max. 27
Content:	Introduction to the basics of computer graphics and visual computing, virtual and augmented reality, and 3D modelling.
Learning outcomes:	Upon completion of this elective module, students will master relevant methods from the fields of visual computing and computer graphics, and also the implementation of augmented reality and virtual reality experiences.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, VU
Prerequisites for participation:	Basic knowledge in the fields of software development and computer graphics.
Frequency in which the module is provided:	Every academic year

Elective Module C6	**Games Engineering – Projects and Seminars**
ECTS credit points:	10–14.5
Content:	Deepening the knowledge of concepts, techniques and applications in the field of games engineering.
Learning outcomes:	Consolidation of knowledge in various topics within the framework of practice-oriented courses and seminars.
Teaching and learning activities and methods:	Project and seminar papers
Prerequisites for participation:	Basic knowledge in the fields of software development and computer graphics
Frequency in which the module is provided:	Every academic year

Module Group Information Security:

Compulsory Module D1	Information Security – Compulsory 1
ECTS credit points:	10
Content:	This module teaches basics in the fields of cryptography and the security of software systems. Using concrete practical examples, both cryptographic and programming security mechanisms are analysed and designed. Simultaneously, students are taught the principles and theoretical foundations of cryptography and secure programming.
Learning outcomes:	Upon completion of the module, students are familiar with basic aspects of cryptography and the secure implementation of software and are able to put them into practice.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE
Prerequisites for participation:	Basic knowledge in information security, e.g. the course in "Information Security."
Frequency in which the module is provided:	Every academic year

Compulsory Module D2	Information Security – Compulsory 2
ECTS credit points:	10
Content:	This module teaches the basics in the fields of designing secure systems/applications and checking the correctness of concrete implementations in practice. Introduction of concepts and methodologies based on selected application scenarios. In addition, safety analyses are conducted and basic design techniques are taught. Furthermore, the basics of test strategies and formal techniques for checking the correctness of software and hardware are presented. These will also be deepened based on practical examples.
Learning outcomes:	Upon completion of the module, students are familiar with basic aspects of safe system design and techniques for verifying concrete implementations and are able to put these into practice.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE
Prerequisites for participation:	Basic knowledge in information security, e.g. the course in "Information Security."
Frequency in which the module is provided:	Every academic year

Elective Module D3	Information Security – Cryptology & Privacy
ECTS credit points:	max. 20.5
Content:	This module provides in-depth knowledge of basic and applied aspects of cryptography and also techniques for the protection of data and privacy. Topics include cryptanalysis methods to analyse the mathematical security of symmetric and asymmetric cryptographic algorithms, modern cryptographic. protocols and technical approaches to privacy protection, basics of complexity theory, and coding theory. The contents covered range from classical basics to current research questions in the field of cryptography.
Learning outcomes:	Upon completion of the module, students will have a sound overview and in-depth theoretical and practical knowledge of the many possible applications and security features of modern cryptography and also of the technical and mathematical possibilities of data protection.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Completion of the course "Cryptography"
Frequency in which the module is provided:	Every academic year

Elective Module D4	Information Security – System Security
ECTS credit points:	max. 25
Content:	This module offers a comprehensive consolidation of the knowledge in system design and system security. Essential fields in this context are hardware architectures, operating systems, compilers, networks and in particular side-channel attacks that occur at the interfaces of the technologies. The contents are taught in a practice-oriented manner. Therefore, practical exercises for the design and safety analysis of systems are an essential part of the module.
Learning outcomes:	Upon completion of the module, students will have a deeper understanding of the structure and security of digital systems. This ranges from hardware to applications in the cloud.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Completion of the course “Secure Software Development”
Frequency in which the module is provided:	Every academic year

Elective Module D5	Information Security – Formal Methods
ECTS credit points:	max. 25
Content:	This module provides advanced testing and verification methods for hardware and software. It teaches the theoretical principles of logic, probability theory and stochastics, which are necessary for the precise specification of security-critical properties of systems and the modelling and analysis of systems and security risks. The module includes intelligent fully automated testing methods, which use system models to automate test activities, and model-based verification methods, which are able to prove the accuracy of a system description with respect to a formal specification.
Learning outcomes:	Upon completion of the module, students are able to model complex, security-critical systems and analyse them using state-of-the-art testing and verification methods in order to achieve maximum test coverage and guarantee critical system properties in a verifiable manner.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Completion of the course “Verification and Testing”
Frequency in which the module is provided:	Every academic year

Elective Module D6	Information Security – Secure Applications
ECTS credit points:	max 20.5
Content:	This module covers questions in the area of the concrete implementation of security-relevant applications in practice. In addition to the subject area of mobile security and the protection of products from their design to the end of the product life cycle, fundamental legal issues are also taught. Furthermore, the module also teaches the basics for the design of fault-tolerant systems and basics in the field of data analysis.
Learning outcomes:	Upon completion of the module, students will have a sound overview of technical and legal aspects of implementing security-critical applications in practice.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Completion of the course “Secure Application Design”
Frequency in which the module is provided:	Every academic year

Elective Module D7	Information Security – Projects and Seminars
ECTS credit points:	10–15
Content:	Practical and/or theoretical implementation of a specific topic from a subfield of information security. Independent review of the relevant literature and derivation of an assignment. Analysis and processing of the problem and drawing the necessary conclusions. Preparation of written contributions and oral presentations. This module also serves as preparation for the master's thesis.
Learning outcomes:	After successful completion of the course, students have developed a deeper understanding of scientific working methods and are able to carry out scientific work with simple assignments independently, and to produce a written paper on them. Students are able to present scientific results orally and discuss them in a group.
Teaching and learning activities and methods:	Independent work under supervision, presentations, discussion in groups.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Module Group Intelligent Systems:

Compulsory Module E1	Intelligent Systems – Compulsory 1
ECTS credit points:	9.5
Content:	Transfer of knowledge on essential methods and techniques of artificial intelligence by means of practical examples from industrial challenges. Increasing knowledge of knowledge representation approaches and inference methods. Theoretical basics are consolidated accordingly through practical exercises and the implementation of concrete software systems.
Learning outcomes:	Upon completion of the module, students are familiar with essential methods of artificial intelligence and its application in so-called AI-based systems. In this context they are also able to identify the appropriate approach for specific problems and to implement solutions accordingly.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU
Prerequisites for participation:	Basic knowledge of methods of artificial intelligence.
Frequency in which the module is provided:	Every academic year

Compulsory Module E2	Intelligent Systems – Compulsory 2
ECTS credit points:	10
Content:	This module teaches essential methods and techniques from the fields of natural language processing and intelligent user interfaces. In this context, it is about the integration of AI methods in the design of user interfaces. Theoretical basics are consolidated accordingly through practical exercises and the implementation of concrete software systems.
Learning outcomes:	Upon completion of the module, students are familiar with essential methods of natural language processing and intelligent user interfaces. In this context, they are also able to identify the appropriate solution for specific problems and to design and implement user interfaces under consideration of essential usability criteria.
Teaching and learning activities and methods:	Combination of theoretical and practical courses: VU
Prerequisites for participation:	Basic knowledge of methods of artificial intelligence.
Frequency in which the module is provided:	Every academic year

Elective Module E3	Intelligent Systems – Artificial Intelligence
ECTS credit points:	max. 11
Content:	Teaching of basic and advanced methods and techniques of artificial intelligence. A central focus in this context is also on specific application areas, including knowledge-based configuration and robotics.
Learning outcomes:	Upon completion of this module, students will have a basic understanding of techniques and methods, especially in the field of "Symbolic AI" and how these can be linked to approaches from the area of "Subsymbolic AI."
Teaching and learning activities and methods:	Combination of theoretical and practical courses: VU, VO, UE
Prerequisites for participation:	Basic knowledge in logic and artificial intelligence.
Frequency in which the module is provided:	Every academic year

Elective Module E4	Intelligent Systems – Data Mining and Machine Learning
ECTS credit points:	max. 29.5
Content:	This module teaches basic and advanced methods and techniques of "Subsymbolic AI." In addition to different machine learning approaches, students will be introduced to brain computation methods. Basic methods of data analysis with corresponding tool support are another module focus.
Learning outcomes:	Upon completion of this module, students will have a basic understanding of techniques and methods, especially in the field of "Subsymbolic AI."
Teaching and learning activities and methods:	Combination of theoretical and practical courses: VU, VO, UE, KU
Prerequisites for participation:	Basic knowledge in artificial intelligence.
Frequency in which the module is provided:	Every academic year

Elective Module E5	Intelligent Systems – Robotics
ECTS credit points:	max. 17.5
Content:	This module teaches basic and advanced methods and techniques of the field of robotics, such as, amongst others, mobile robots, navigation systems, context-aware computing and further associated topics.
Learning outcomes:	Upon completion of this module, students will have a basic understanding of techniques and methods, especially in the field of Robotics.
Teaching and learning activities and methods:	Combination of theoretical and practical courses: VU, VO, LU, UE
Prerequisites for participation:	Basic knowledge in artificial intelligence.
Frequency in which the module is provided:	Every academic year

Elective Module E6	Intelligent Systems – Software Technology
ECTS credit points:	max. 15.5
Content:	This module teaches basic and advanced knowledge in the field of software technology with a strong focus on development processes (how to create software), analysis and design approaches, development of mobile and web-based systems and application in the field of adaptive systems, amongst others by using the example of recommender systems.
Learning outcomes:	Upon completion of the module, students will have a basic understanding of software processes and corresponding implementation technologies.
Teaching and learning activities and methods:	Combination of theoretical and practical courses: VU, VO, LU
Prerequisites for participation:	Basic knowledge in the field of software technology.
Frequency in which the module is provided:	Every academic year

Elective Module E7	Intelligent Systems – Projects and Seminars
ECTS credit points:	10–15
Content:	Practice-oriented implementation of intelligent systems and preparation of issues related to intelligent systems within the framework of interactive seminar events.
Learning outcomes:	Consolidation of knowledge in specific topics from the field of “Intelligent Systems.”
Teaching and learning activities and methods:	Preparation of the subjects within the framework of practice-oriented courses and seminars.
Prerequisites for participation:	Basic knowledge in the field of software technology.
Frequency in which the module is provided:	Every academic year

Module Group Interactive and Visual Information Systems:

Compulsory Module F1	Interactive and Visual Information Systems – Compulsory 1
ECTS credit points:	11.5
Content:	Information systems serve as an interface between data and users to solve a wide variety of application tasks and problems. Information systems are used to store, index and search data, and also to analyse and explore data. They are a vital component of any information infrastructure. The focus of this module is on approaches for the design, development and evaluation of user-related information systems, including visual-interactive technologies for the representation, navigation, search, exploration, analysis and presentation of data and documents.
Learning outcomes:	Understand, apply, develop and evaluate concepts for effective and efficient visual and interactive information systems.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, VU, SE, PT
Prerequisites for participation:	Basic knowledge of databases, human-machine interaction, data structures and algorithms.
Frequency in which the module is provided:	Every academic year

Compulsory Module F2	Interactive and Visual Information Systems – Compulsory 2
ECTS credit points:	8
Content:	Information systems serve as an interface between data and users to solve a wide variety of application tasks and problems. Information systems are used to store, index and search data, and also to analyse and explore data. They are a vital component of any information infrastructure. The compulsory courses of this module focus on web technologies and evaluation methodology.
Learning outcomes:	Understand, apply, develop and evaluate concepts for effective and efficient visual and interactive information systems.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VU
Prerequisites for participation:	Basic knowledge of databases, human-machine interaction, data structures and algorithms.
Frequency in which the module is provided:	Every academic year

Elective Module F3	Interactive and Visual Information Systems – Mobile and Web Applications
ECTS credit points:	max. 21.5
Content:	The further development of data networks and portable devices creates new applications for information systems in mobile and distributed environments. This elective module investigates, implements and evaluates concepts and techniques for the design and realisation of visual and interactive information systems for mobile and distributed environments.
Learning outcomes:	Design, implementation and evaluation of visual and interactive information systems for mobile and distributed/web-based applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO
Prerequisites for participation:	Basic knowledge of databases, human-machine interaction, data structures and algorithms.
Frequency in which the module is provided:	Every academic year

Elective Module F4	Interactive and Visual Information Systems – Data Mining and Artificial Intelligence
ECTS credit points:	max. 32.5
Content:	Automatic methods of data analysis are an important basis for the development of modern information systems. Examples are the personalisation of information services (recommending), the analysis of information for data exploration and classification, and decision support (e.g. cluster analysis, classification, relevance feedback, predictive analysis). This elective module teaches concepts and techniques for the automatic analysis and visualisation of data, such as architectures for efficient data search and analysis, recommender system technologies, visual and multimedia information retrieval, and also visual and interactive data analysis.
Learning outcomes:	Design, implementation and evaluation of intelligent information systems.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU
Prerequisites for participation:	Basic knowledge of databases, human-machine interaction, data structures and algorithms.
Frequency in which the module is provided:	Every academic year

Elective Module F5	Interactive and Visual Information Systems – Computer Games
ECTS credit points:	max. 15
Content:	Computer games have become an especially important interactive medium, used not only for entertainment but also for learning, teaching and creativity. This elective module teaches concepts and techniques of computer games, such as design and development models, and also techniques of simulation and animation, and interactive data and knowledge visualisation.
Learning outcomes:	Design, implementation and evaluation of computer games in all application areas, including learning/teaching and serious gaming.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VU
Prerequisites for participation:	Basic knowledge in the field of human-machine interaction, visual systems.
Frequency in which the module is provided:	Every academic year

Elective Module F6	Interactive and Visual Information Systems – Projects and Seminars
ECTS credit points:	10–15
Content:	Deepening the knowledge of concepts, techniques and applications in the field of interactive and visual information systems.
Learning outcomes:	In-depth individual occupation with methods of the subject on the basis of seminar papers, including review and presentation of current research contributions. In the area of projects, the independent processing of a more comprehensive development or research task in the field of interactive and visual information systems.
Teaching and learning activities and methods:	Project and seminar papers
Prerequisites for participation:	Basic knowledge in the field of human-machine interaction, visual systems.
Frequency in which the module is provided:	Every academic year

Module Group Machine Learning:

Compulsory Module G1	Machine Learning – Compulsory 1
ECTS credit points:	10
Content:	This module examines mathematical basics and applications of machine learning and deep learning in particular.
Learning outcomes:	Upon successful completion of the module, students understand the mathematical basics of machine learning and deep learning and can apply them in practical examples.
Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of theoretical and practical examples.
Prerequisites for participation:	Basic knowledge in machine learning.
Frequency in which the module is provided:	Every academic year

Compulsory Module G2	Machine Learning – Compulsory 2
ECTS credit points:	5
Content:	This module examines mathematical basics and applications of autonomous learning. Particular attention is given to the subject area of reinforcement learning.
Learning outcomes:	Upon successful completion of the module, students will understand the basics of autonomous learning and basic mathematical concepts in reinforcement learning. Students can apply this basic knowledge to simple problems.
Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of theoretical and practical examples.
Prerequisites for participation:	Basic knowledge in machine learning.
Frequency in which the module is provided:	Every academic year

Elective Module G3	Machine Learning – Learning Architectures
ECTS credit points:	max. 14.5
Content:	This module provides basic knowledge of machine learning and also knowledge of the architecture of biological and artificial learning systems. From the biological point of view, the principles of calculating and learning in the brain are discussed. With regard to artificial systems, it covers the architectures of large machine learning systems.
Learning outcomes:	Upon successful completion of the module, students will understand the basics of machine learning and will have become familiar with various principles of biological and artificial learning architectures. They will be able to apply the principles and methods learned to simple practical problems.

Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of theoretical and practical examples.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module G4	**Machine Learning – Signal Processing**
ECTS credit points:	max. 30
Content:	This module covers the basics for all levels of speech signal processing up to automatic speech recognition, speech synthesis and dialogue systems. Another focus is on adaptive and non-linear signal processing.
Learning outcomes:	Upon successful completion of the module, students will understand the basics of adaptive and non-linear signal processing, linguistics and human-machine communication using spoken language. The students will be able to apply the methods taught to practical problems.
Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of examples.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module G5	**Machine Learning – Optimisation**
ECTS credit points:	max. 12
Content:	Many machine learning methods use optimisation algorithms to optimise models. This module provides more in-depth basic knowledge in optimisation.
Learning outcomes:	Upon completion of this elective module, students will have a sound basic knowledge of mathematical optimisation methods.
Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of examples.
Prerequisites for participation:	Basic knowledge in analysis, linear algebra and algorithms.
Frequency in which the module is provided:	Every academic year

Elective Module G6	**Machine Learning – Statistics and Data Mining**
ECTS credit points:	max. 33.5
Content:	This module provides basic knowledge in data mining, statistics and the analysis of substantial amounts of data. This subject not only covers the theoretical basics in detail – significant importance is also attached to practical implementation.
Learning outcomes:	After completing the subject, students are familiar with the essential basics of data science and are also able to implement these in practical applications.
Teaching and learning activities and methods:	Multimedia-supported lecture. Contents are processed and discussed by means of examples.
Prerequisites for participation:	Basic knowledge in vector and matrix calculus, elementary differential calculus and probability theory and statistics.
Frequency in which the module is provided:	Every academic year

Elective Module G7	**Machine Learning – Projects and Seminars**
ECTS credit points:	10–15
Content:	Practical and/or theoretical implementation of a specific topic from a subfield of machine learning. Independent review of the relevant literature and derivation of an assignment. Analysis and processing of the problem and drawing the necessary conclusions. Preparation of written contributions and oral presentations. This module also serves as preparation for the master's thesis.
Learning outcomes:	After successful completion of the course, students have developed a deeper understanding of scientific working methods and are able to carry out scientific work with simple assignments independently, and

	to produce a written paper on them. Students are able to present scientific results orally and discuss them in a group.
Teaching and learning activities and methods:	Independent work under supervision, presentations, discussion in groups.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Module Group Robotics:

Compulsory Module H1	**Robotics – Compulsory 1**
ECTS credit points:	10
Content:	This module provides a comprehensive introduction to mobile robots with a focus on mathematical description of robot systems and methods to solve fundamental problems such as localisation, path planning and mapping.
Learning outcomes:	Upon completion of the module, students will have a basic understanding of mobile robots and will be able to describe mobile robot systems and solve fundamental tasks.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in discrete mathematics, linear algebra and programming.
Frequency in which the module is provided:	Every academic year

Compulsory Module H2	**Robotics – Compulsory 2**
ECTS credit points:	10
Content:	This module offers a comprehensive deepening of knowledge in the fields of perception and decision making in robot systems. It covers specific topics from computer vision, knowledge representation and reasoning.
Learning outcomes:	Upon completion of the module, students will be able to develop modules for robot systems that “see” and “conclude.”
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in computer vision and logic.
Frequency in which the module is provided:	Every academic year

Elective Module H3	**Robotics – Foundations of Robotics**
ECTS credit points:	max. 23
Content:	This module offers a comprehensive deepening of knowledge in core areas of robotics such as kinematics, robot arms, and navigation.
Learning outcomes:	Upon completion of the module, students will have a sound knowledge of the core areas of robotics and can use this knowledge to design appropriate modules for robot systems.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in discrete mathematics, linear algebra and programming.
Frequency in which the module is provided:	Every academic year

Elective Module H4	Robotics – Data Mining and Machine Learning
ECTS credit points:	max. 44
Content:	The development of intelligent robot systems requires methods from the fields of knowledge acquisition, machine learning and mathematics. This module teaches the basics of the required methods.
Learning outcomes:	Upon completion of the module, students will have a sound overview of methods of acquiring knowledge and models, machine learning and optimisation and will be able to apply these methods to solve tasks in robotics.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in discrete mathematics, linear algebra and programming.
Frequency in which the module is provided:	Every academic year

Elective Module H5	Robotics – Artificial Intelligence
ECTS credit points:	max. 8
Content:	This module provides a deepening of knowledge in the field of symbolic methods of artificial intelligence to represent and solve complex decision processes in robot systems.
Learning outcomes:	Upon completion, students will be able to select suitable representations for problems in decision making and to model these problems and solve them with suitable tools.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in discrete mathematics, logic and programming.
Frequency in which the module is provided:	Every academic year

Elective Module H6	Robotics – Computer Vision
ECTS credit points:	max. 10
Content:	This module provides a deeper understanding of camera-based robot systems. This includes methods for stationary, ground-based and flying robot systems.
Learning outcomes:	Upon completion of the module, students are able to solve perception problems in robot systems with the help of computer vision.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in computer vision and programming.
Frequency in which the module is provided:	Every academic year

Elective Module H7	Robotics – Software Engineering
ECTS credit points:	max. 19
Content:	Consolidation of knowledge in the field of software engineering with a focus on robot systems. This includes software architectures, concepts and development methods for Cyber Physical Systems and Embedded Systems.
Learning outcomes:	Upon completion of this module, students are able to design, implement, and validate a software system for a robot.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in software engineering and programming.
Frequency in which the module is provided:	Every academic year

Elective Module H8	Robotics – Projects and Seminars
ECTS credit points:	10–15
Content:	Teaching of advanced contents in the field of robotics, which students are expected to carry out largely independently under supervision.
Learning outcomes:	After successful completion of the course, students have developed a deeper understanding of scientific working methods and are able to carry out scientific work with simple assignments independently, and to produce a written paper on them. Students are able to present scientific results orally and discuss them in a group.
Teaching and learning activities and methods:	Independent work under supervision, presentations, discussion in groups.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Module Group Software Technology:

Compulsory Module I1	Software Technology – Compulsory 1
ECTS credit points:	10
Content:	Introduction to the basics of software technology with focus on programming languages and their principles. This includes the basics of programming languages and compiler development.
Learning outcomes:	Upon completion of this module, students are able to develop their own programming languages and respective compilers. In addition, students can analyse and evaluate different concepts of programming languages and their special features.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, VU
Prerequisites for participation:	Basic knowledge in data structures, programming and discrete mathematics.
Frequency in which the module is provided:	Every academic year

Compulsory Module I2	Software Technology – Compulsory 2
ECTS credit points:	9.5
Content:	Introduction to the basics of verification and testing as well as the efficient creation of software with the help of Design Patterns.
Learning outcomes:	Upon completion of this module, students are able to create programmes based on design patterns and ensure their correctness through formal verification and software testing.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE
Prerequisites for participation:	Basic knowledge of data structures, programming and discrete mathematics.
Frequency in which the module is provided:	Every academic year

Elective Module I3	Software Technology – Artificial Intelligence and Theoretical Computer Science
ECTS credit points:	max. 20.5
Content:	Introduction to the basics of Artificial Intelligence and its application such as Configuration, Recommender Systems, and Diagnosis.
Learning outcomes:	In this elective module, students are taught the basics of logic-based Artificial Intelligence. Graduates will also gain insight into the development of tools based on Artificial Intelligence to solve practical problems.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU, KU
Prerequisites for participation:	Basics in logic and mathematics. Basics of algorithms, data structures and programming

Frequency in which the module is provided:	Every academic year

Elective Module I4	**Software Technology – Modelling and Formal Methods**
ECTS credit points:	max. 20
Content:	Imparting the basic knowledge on formal methods for the creation of specifications and formal verification.
Learning outcomes:	Students who complete this elective module receive an in-depth introduction to the specification and modelling of systems with the aim of formal system verification.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU, VU
Prerequisites for participation:	Basics in logic and mathematics. Basics of algorithms, data structures and programming
Frequency in which the module is provided:	Every academic year

Elective Module I5	**Software Technology – Software Design and Architecture**
ECTS credit points:	max. 18
Content:	Introduction to the basics of system and software architectures based on practical examples such as databases and machine learning software.
Learning outcomes:	In this elective module, students are taught the basics of architectures by means of various applications.
Teaching and learning activities and methods:	A combination of practice-oriented courses: VU
Prerequisites for participation:	Basics of algorithms, data structures and programming. Basics of machine learning and databases.
Frequency in which the module is provided:	Every academic year

Elective Module I6	**Software Technology – Software Engineering**
ECTS credit points:	max. 31
Content:	Extension of knowledge in the field of software engineering for mobile applications and also fields of application, such as software maintenance. The module also provides in-depth knowledge in the areas of quality assurance and software development.
Learning outcomes:	In this elective module, students gain an in-depth insight into modern software development with a focus on quality assurance, processes, other fields of application such as software maintenance and the generation of mobile applications.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU, LU, VU
Prerequisites for participation:	Basics of algorithms, data structures and programming
Frequency in which the module is provided:	Every academic year

Elective Module I7	**Software Technology – Safe and Secure Systems**
ECTS credit points:	max. 20
Content:	Introduction to the basics of creating safe and secure systems based on software. The development of secure software and also the review of software with regard to the requirements for safety critical systems are discussed.
Learning outcomes:	Students receive a solid foundation for the creation of Safe and Secure Software.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU
Prerequisites for participation:	Basics in logic and mathematics. Basics of algorithms, data structures and programming
Frequency in which the module is provided:	Every academic year

Elective Module I8	Software Technology – Projects and Seminars
ECTS credit points:	10–15
Content:	Teaching of advanced contents in the field of robotics, which students are expected to carry out largely independently under supervision.
Learning outcomes:	After successful completion of the course, students have developed a deeper understanding of scientific working methods and are able to carry out scientific work with simple assignments independently, and to produce a written paper on them. Students are able to present scientific results orally and discuss them in a group.
Teaching and learning activities and methods:	Independent work under supervision, presentations, discussion in groups.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Module Group Visual Computing:

Compulsory Module J1	Visual Computing – Compulsory 1
ECTS credit points:	10
Content:	Basic methods of image processing, pattern recognition and real-time graphics
Learning outcomes:	Upon completion of this compulsory module, students are proficient in basic techniques of image processing, pattern recognition and real-time graphics.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU
Prerequisites for participation:	Basic knowledge in image processing, computer graphics and numerical optimisation
Frequency in which the module is provided:	Every academic year

Compulsory Module J2	Visual Computing – Compulsory 2
ECTS credit points:	10
Content:	Basic methods of machine vision and 3D modelling in computer graphics.
Learning outcomes:	Upon completion of this compulsory module, students have a profound basic knowledge of machine vision and the three-dimensional modelling of objects.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, KU, VU
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module J3	Visual Computing – Foundations of Visual Computing
ECTS credit points:	max. 26.5
Content:	Advanced basic knowledge in mathematics, optimisation and machine learning.
Learning outcomes:	Upon completion of this elective module, students will have profound basic mathematical knowledge of the methods of visual computing.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, KU, VU
Prerequisites for participation:	Basic knowledge in analysis and linear algebra.
Frequency in which the module is provided:	Every academic year

Elective Module J4	Visual Computing – Computer Graphics
ECTS credit points:	max. 17.5
Content:	Further courses in computer graphics, geometry processing and GPU programming.
Learning outcomes:	Upon completion of this elective module, students possess knowledge of advanced methods from computer graphics and are proficient in the corresponding programming languages.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, VU
Prerequisites for participation:	Compulsory Module J1
Frequency in which the module is provided:	Every academic year

Elective Module J5	Visual Computing – Computer Vision
ECTS credit points:	max. 20
Content:	Further courses in the fields of image and video understanding, machine vision and medical image processing.
Learning outcomes:	Upon completion of this elective module, students are proficient in advanced methods for extracting and analysing information from images and videos and solving practical problems such as navigating with drones or answering medical questions.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, VU, KU, LU
Prerequisites for participation:	Compulsory Module J1
Frequency in which the module is provided:	Every academic year

Elective Module J6	Visual Computing – Visualisation and Virtual Reality
ECTS credit points:	max. 37
Content:	Further courses in the fields of visualisation, animation, virtual and augmented reality and 3D modelling.
Learning outcomes:	Upon completion of this elective module, students are proficient in the relevant methods of visualisation, virtual and augmented reality, animation and 3D modelling. In this elective module, great attention is paid to the close connection between theoretical content and practical implementation.
Teaching and learning activities and methods:	Lectures with integrated exercises: VU
Prerequisites for participation:	Compulsory Module J1
Frequency in which the module is provided:	Every academic year

Elective Module J7	Visual Computing – Projects and Seminars
ECTS credit points:	10–15
Content:	Project and seminars
Learning outcomes:	Upon completion of the seminars from this elective module, students have acquired specialist knowledge from current topics in Visual Computing. Upon completion of the project, students can use this expertise to solve practical problems independently.
Teaching and learning activities and methods:	Seminars and project: SE, PT
Prerequisites for participation:	Compulsory Module J1
Frequency in which the module is provided:	Every academic year

Module Groups Business:

Compulsory Module K1	Business Informatics – Compulsory 1
ECTS credit points:	4.5
Content:	This module provides relevant knowledge in the areas of Engineering and Management of Business Information Systems. Particular emphasis is placed on the areas of business IT applications (ERP, SCM, etc.), aspects of system design and system development, business information systems, informatics management and IT governance.
Learning outcomes:	Upon completion of the compulsory module, students are able to understand the functional and design principles of modern business information systems and identify potential areas of application. Graduates of this compulsory module will gain an understanding of the principles of modern IT systems and will be able to play an active and major part in IT implementation projects.
Teaching and learning activities and methods:	Lecture with practical examples (VO), case studies, research on selected topics and practical projects (UE)
Prerequisites for participation:	Basic knowledge in the fields of software development and databases.
Frequency in which the module is provided:	Every academic year

Elective Module K2	Business Informatics
ECTS credit points:	min. 15.5
Content:	This module provides in-depth knowledge on the use of information and communication technologies in the economy. Particular emphasis is placed on the practical implementation of theoretical concepts from the fields of IT system design and IT architecture, business modelling and simulation and quantitative methods for business. The content learnt is discussed and implemented in practice using specific tasks from the business context.
Learning outcomes:	Upon completion of this Business Informatics module, students are capable of applying their knowledge in the field of software engineering and management in a targeted manner in a business environment.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU and seminar/project paper
Prerequisites for participation:	Basic knowledge in the fields of software development and databases.
Frequency in which the module is provided:	Every academic year

Compulsory Module L1	Industrial Management and Innovation – Compulsory 1
ECTS credit points:	6.5
Content:	Principles of industrial management and the management of innovation, production and logistics. Basic methods and concepts are taught starting from the product idea and product development to the marketing of goods and services in an industrial environment.
Learning outcomes:	Upon completion of the courses, students are able to apply concepts and methods of innovation and industrial management.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE (in some cases with case studies in the Harvard Seminar Room).
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module L2	Industrial Management and Innovation
ECTS credit points:	min. 13.5
Content:	In-depth knowledge of management from the generation of ideas to the production of innovative products in industrial companies. From the idea to a marketable, patented product, from workplace design to the planning of an entire factory, aspects of sustainability as well as optimisation of production and logistics networks are covered.

Learning outcomes:	Upon completion of the courses, students are familiar with the essential contents of the product development process starting from the product idea to industrial production. Students are able to analyse challenges along the entire value-added chain of a company in a structured manner and to develop proposals for solutions.
Teaching and learning activities and methods:	Frontal lecture with media support, exercises and seminars with case studies, Harvard case studies in the Harvard seminar room and group exercises, partly conducted in the Schumpeter Laboratory for Innovation (FabLab) and in the learning factory (LEAD Factory).
Prerequisites for participation:	Basic knowledge in innovation and industrial management is recommended.
Frequency in which the module is provided:	Every academic year, in some cases every semester

Compulsory Module M1:	**Management and Strategy – Compulsory 1**
ECTS credit points:	9
Content:	In this module, students learn about corporate management and organisation as well as information management. Students learn how companies develop strategies and build their organisation. Furthermore, the strategic relevance of information systems is examined in detail.
Learning outcomes:	Upon completion of the compulsory module, students are able to understand concepts of business management and apply them in practice. Graduates of this compulsory module gain an understanding of the role information systems play in corporate strategy.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU
Prerequisites for participation:	Basic knowledge in business administration
Frequency in which the module is provided:	Every academic year

Elective Module M2	**Management and Strategy**
ECTS credit points:	min. 10
Content:	In this module, students deepen their knowledge of particular topics of corporate management. Students learn the basics of setting up a company, as well as how to make well-informed strategic decisions and to implement them in the company. Knowledge of business model development, technology management and process management, among others, complete the profile. In addition to knowledge of the theoretical basics, great importance is attached to practical implementation and application.
Learning outcomes:	Upon completion of this subject, students have extensive knowledge in selected aspects of corporate management, including strategic matters. The aim is also to promote an entrepreneurial spirit.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU and seminar/project paper
Prerequisites for participation:	Basic knowledge in business administration, corporate management and organisation
Frequency in which the module is provided:	Every academic year

Compulsory Module N1	**Management Control, Accounting and Finance – Compulsory 1**
ECTS credit points:	7.5
Content:	Management Control, Accounting and Finance is a business administration tool that serves to ensure the viability of a company and make it attractive for investors. This module provides students with the relevant in-depth knowledge of this tool, with the aim of managing the company successfully in financial terms. For this purpose, the core competencies from the key financial areas of Management Control Systems and financial management are taught both in a national and international context. In addition to a practice-oriented selection of

	teaching content, particular emphasis is also placed on developing the corresponding methodical skills reflecting the state of the art of science and practice.
Learning outcomes:	Upon completion of the module, students are equipped with the key instruments of financial management and are able to assume management responsibility in these areas in the medium term. In addition, students will also be able to act as a competent interface to the external financial world of the company in their future position within the company.
Teaching and learning activities and methods:	Taking into account the dimensions of the teaching objectives and the level of competence, the spectrum ranges from content-centred frontal lectures to joint processing of learning-supporting exercises and case studies, all the way to group exercises and strongly activity-centred case studies.
Prerequisites for participation:	Prerequisite is the completion of the compulsory courses Accounting for Computer Science Studies and Business Economics from the bachelor's degree programme.
Frequency in which the module is provided:	Every academic year

Elective Module N2	**Management Control, Accounting and Finance**
ECTS credit points:	min. 12.5
Content:	In terms of content, the elective module is divided into the three areas "Management Control, Accounting and Finance", "Industrial Marketing, Purchasing and Supply Management" and "Human Resource Management and Industrial Sociology", which allow for a more in-depth study depending on the interests of the students. In addition to in-depth courses in these areas, comprehensive courses on Research Design and Entrepreneurship are offered.
Learning outcomes:	Upon completion of the module, students are able to interpret the financial and economic calculations of companies and to manage a company with regard to financial and legal aspects. Special attention is given to value/performance management. In addition, students are able to organise and control the purchasing and sales activities within the company in a well-founded manner, both with regard to internal company conditions and external market developments. Finally, students acquire knowledge in the areas of operational personnel management (including presentation techniques) and the corresponding legal framework.
Teaching and learning activities and methods:	Taking into account the dimensions of the teaching objectives and the level of competence, the spectrum ranges from content-centred frontal lectures to joint processing of learning-supporting exercises and case studies, all the way to group exercises and strongly activity-centred case studies.
Prerequisites for participation:	Knowledge of general business administration, especially in the areas of external/internal corporate accounting, financing, investment and marketing.
Frequency in which the module is provided:	Every academic year

Module Groups Route-63:

Compulsory Module O1	Digital Entrepreneurship – Compulsory 1
ECTS credit points:	7
Content:	This module deals with entrepreneurship in the sense of "entrepreneurial thinking and acting", as well as customer orientation which consists of a consistent customer approach across all touchpoints.
Learning outcomes:	Upon completion of this module, students are sensitised to an understanding of marketing in terms of customer orientation. They understand the importance of entrepreneurship, know ways and means of clarifying individual issues when starting a business, specifics of "Entrepreneurial Management", and understand structures and environments that promote entrepreneurship.
Teaching and learning activities and methods:	Mix of theoretically oriented courses and interactive components: VO, KS
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module O2	Digital Entrepreneurship
ECTS credit points:	min. 13
Content:	Strategic marketing, product and brand management, price management, communication management, distribution management, efficient capital markets, Internet-based business models.
Learning outcomes:	Upon completion of the subject, students are equipped with the key instruments of the marketing management process and are able to design and implement the essential tasks of marketing.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU and seminar/project paper
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Compulsory Module P1	Cognition and Behaviour – Compulsory 1
ECTS credit points:	12
Content:	Introduction to the subject areas of general psychology (perception, attention, learning, memory, higher cognitive functions, emotions, motivation), of neuropsychology and cognitive neuroscience, and of industrial and organisational psychology (definition and development of work, images of people in organisations, regulation of work behaviour, effects of work, work and emotion, work analysis, work design, communication in organisations, teamwork, leadership, HR selection and development).
Learning outcomes:	Upon completion of this module, students will be aware of and understand basic terms and current research results in the above-mentioned fields. They are able to assess their scientific and practical significance.
Teaching and learning activities and methods:	Theoretically oriented courses: VO
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module P2	Cognition and Behaviour
ECTS credit points:	min. 8
Content:	The module offers access to the most important basics of psychology, brain research and decision making. In addition, the fundamentals of empirical research in psychology are offered in the form of experiments and surveys.

Learning outcomes:	Teaching of advanced contents in the field of software technology, which should be carried out by students largely independently under supervision. Learning the basics of empirical research methods in psychology.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, VU and seminars
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Compulsory Module Q1	**Current Societies – Compulsory 1**
ECTS credit points:	12
Content:	Basics of sociology and empirical social research, their social relevance and history and different approaches of sociological thinking.
Learning outcomes:	Upon completion of the module, students are familiar with the basic concepts, problems and perspectives of sociology and the history of empirical social research. They have an overview of the diversity of sociology in terms of the various theoretical assumptions and methodological approaches relevant to it.
Teaching and learning activities and methods:	Theoretically oriented courses: VO
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module Q2	**Current Societies**
ECTS credit points:	min. 8
Content:	The module provides access to the most important foundations in social analysis and sociological theory, including insights into central sociological concepts and theories, their history and knowledge of modern society. In addition, the module focuses on empirical social research.
Learning outcomes:	Understanding of basic methods and concepts of sociology and a deeper understanding of the methods and ways of using Data Science in sociology.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU and seminar/project paper
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Compulsory Module R1	**Business Law – Compulsory 1**
ECTS credit points:	5
Content:	Introduction to data protection law from the perspective of technical professions.
Learning outcomes:	Upon completion of the module, students have knowledge of the data protection legal framework in connection with technical professions. They are able to identify and classify questions related to the handling of personal data in business practice and to solve smaller issues themselves. The aim is to ensure responsible handling of personal data in a professional context.
Teaching and learning activities and methods:	Interactive with new media (knowledge transfer is also computer-based, e.g. eLearning)
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module R2	Business Law
ECTS credit points:	min. 15
Content:	The module provides access to the most important fundamentals of public commercial law, corporate and company law and the protection of intellectual property.
Learning outcomes:	Upon completion of the module, students are able to understand the basic functions of state supervision of economic life, the importance of trade law as a "model field of law" for economic activities and to exercise responsible professional handling of personal data.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, UE, VU and seminar/project paper
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Elective Module Science, Technology and Society:

Module S	Science, Technology and Society
ECTS credit points:	max. 4
Content:	The courses in this catalogue provide a deeper understanding of the fundamental importance of science and technology for contemporary societies and their role in responsibly addressing societal challenges.
Learning outcomes:	Upon completion of the module, students are able to understand and reflect on the interrelationships between science, technology and society They are familiar with the relevant literature and are able to relate it to the subject-specific problems of their studies.
Teaching and learning activities and methods:	A combination of theoretical and practical courses: VO, VU, SE
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Appendix II. Recommended Free-Choice Courses

Free-choice courses can be freely chosen from among the courses offered at recognised domestic and foreign universities as well as at recognised domestic and foreign post-secondary educational institutions according to § 10 of this curriculum.

For students to broaden their knowledge, courses in the fields of foreign languages, social competence, technological impacts assessment and women's and gender studies are recommended. In particular, the following institutions and service departments are offered:

- Languages, Key Competencies and In-House Training of TU Graz,
- Science, Technology and Society Unit (STS Unit) of TU Graz,
- Treffpunkt sprachen – Centre for Language, Plurilingualism and Didactics at the Uni Graz,
- the transfer initiative for management and entrepreneurship fundamentals, awareness, training and employability ("TIMEGATE"), and
- Centre for Social Competence of Uni Graz.

Appendix III. Equivalence List

Courses for which the equivalence or recognition is defined in this part of the Appendix to the curriculum do not require separate recognition by the officers responsible for study matters. However, attention is drawn to the possibility of individual recognition by written decision in accordance with § 78 Universities Act 2002 (UG).

An equivalence list defines the equivalence of positively completed courses from this present curriculum and the previous curriculum. This equivalence applies in both directions; this means that courses that are successfully completed and included in the previous curriculum may be credited to this curriculum and courses successfully completed and included this curriculum may be credited to the previous curriculum.

Courses that have the same name and type, number of ECTS credit points and the number of semester course hours are considered to be equivalent and are thus not explicitly listed in the equivalence list.

Present curriculum 2020 in the version 2022				**Previous curriculum for 2014 in the version 2016**			
Course	**Type**	**SSt**	**ECTS**	**Course**	**Type**	**SSt**	**ECTS**
Intelligent Systems	VO	2	3	Expert Systems	VO	2	3
Intelligent Systems	KU	1	2	Expert Systems	KU	1	2
Machine Learning 2	VO	2	3	Machine Learning	VO	2	3
Machine Learning 2	KU	1	2	Machine Learning	KU	1	2
Deep Learning	VO	2	3	Neural Networks	VO	2	3
Deep Learning	KU	1	2	Neural Networks	KU	1	2
Knowledge Discovery & Data Mining 1	VO	2	3	Knowledge Discovery & Data Mining 1	VO	2	2.5
Image and Video Understanding	VO	2	3	Image Understanding	VO	2	3
Image and Video Understanding	KU	1	2	Image Understanding	KU	1	2
GPU Programming 0.5 ECTS for free-choice subject	VU	3	5	Real-Time Graphics 2	VO	1	1.5
				Real-Time Graphics 2	KU	2	4
Mathematical Principles in Visual Computing	VU	3	5	Mathematical Principles in Vision and Graphics	VU	3	5
Cryptography	VO	2	3	Applied Cryptography	VO	2	3
Cryptography	KU	1	2	Applied Cryptography	KU	1	2
Cryptanalysis	VO	2	3	Applied Cryptography 2	VO	2	3
Cryptanalysis	KU	1	2	Applied Cryptography 2	KU	1	2
Privacy Enhancing Technologies	VO	2	3	IT Security	VO	2	3
Privacy Enhancing Technologies	KU	1	2	IT Security	KU	1	2

Present curriculum 2020 in the version 2022				Previous curriculum for 2014 in the version 2016			
Course	**Type**	**SSt**	**ECTS**	**Course**	**Type**	**SSt**	**ECTS**
Seminar Cryptology and Privacy	SE	2	3.5	Selected Topics IT Security 2	SE	2	3.5
Secure Software Development	VO	2	3	Security Aspects in Software Development	VO	2	3
Secure Software Development	KU	1	2	Security Aspects in Software Development	KU	1	2
Digital System Integration and Programming	VU	3	5	System-on-Chip Architectures and Modelling	VU	3	5
Side-Channel Security	VU	3	5	Embedded Security	VU	3	5
Mobile Security	VO	2	3	Advanced Computer Networks	VO	2	3
Mobile Security	KU	1	2	Advanced Computer Networks	KU	1	2
Inertial Navigation	VO	2	3	Integrated Navigation	VO	2	3
Inertial Navigation	KU	1	1.5	Integrated Navigation	UE	1	1.5
Computational Modelling of Social Systems	VU	3	4.5	Web Science and Web Technology	VU	2	3
Computational Social Systems 2	VU	3	5	Science 2.0	VU	2	3
Architecture of Database Systems	VU	3	5	Structured Data Management – Advanced Topics	VU	3	5
Information Management 1.5 ECTS for free-choice subject	VU	3	4	Information Management	VO	1	1.5
				Information Management	UE	2	4
Enabling Innovation 2 ECTS for free-choice subject	UE	1	1	Enabling Innovation	UE	2	3
Industrial Engineering	VO	2	3	Industrial Engineering 1	VO	2	3
Industrial Engineering 1 ECTS for free-choice subject	UE	1	1	Industrial Engineering 1	UE	1	2
General Management and Organisation 1 ECTS for free-choice subject	VO	2	2	General Management and Organisation	VO	2	3
Industrial Management and Innovation 1 ECTS for free-choice subject	UE	1	1	Industrial Management and Innovation	UE	1	2
Technology Management	VO	2	3	Technology Management	SE	2	2
Process Management 3 ECTS for free-choice subject	SE	4	4	Process Management	VO	2	3
				Process Management	UE	2	4
Value Engineering	VU	3	3	Value Engineering	VO	1	1.5
				Value Engineering	UE	1	1.5

Present curriculum 2020 in the version 2022				Previous curriculum 2020			
Course	**Type**	**SSt**	**ECTS**	**Course**	**Type**	**SSt**	**ECTS**
Computational Modelling of Social Systems	VU	3	4.5	Computational Social Systems 1	VU	3	4.5
Advanced Information Retrieval	VU	3	5	Web Technology	VU	3	5
Reinforcement Learning	VO	2	3	Autonomously Learning Systems	VO	2	3
Reinforcement Learning	KU	1	2	Autonomously Learning Systems	KU	1	2
Statistics	VO	3	4.5	Statistik	VO	3	4
Statistics	UE	1	1.5	Statistik	UE	1	2

Present curriculum 2020 in the version 2024				Previous curriculum 2020 in the version 2022			
Course	**Type**	**SSt**	**ECTS**	**Course**	**Type**	**SSt**	**ECTS**
Information Visualisation	VU	3	5	Information Visualiation	VU	3	5
Future Studies I: Foundations and ethods	VU	2	4	Futurology	VU	2	4
Nonlinear Optimization	VO	3	4.5	Numerical Optimization	VO	3	4.5
Nonlinear Optimization	UE	2	2.5	Numerical Optimization	UE	2	2.5

If, in the case of recognition for a VU that is based on a VO/UE or VO/KU combination, only part of the course was completed in the previous curriculum, the ECTS credit point part of the completed course will be recognised for the module of the course in the present curriculum.

In general, all courses of a catalogue of electives of the previous curriculum can be recognised in a module group of the present curriculum according to the table below.

Module Group in the present curriculum for 2020	Catalogue of electives of the previous curriculum for 2014, version 2016
E: Intelligent Systems *or* G: Machine Learning *or* H: Robotics	Intelligent Systems
D: Information Security	Secure and Correct Systems
J: Visual Computing	Visual Computing
B: Data Science	Web and Data Science
A: Algorithms and Theoretical Computer Science	Supplementary Catalogue
K: Business Informatics	Business Informatics
L: Industrial Management and Innovation	Industrial Management and Innovation

Module Group in the present curriculum for 2020	Catalogue of electives of the previous curriculum for 2014, version 2016
M: Management and Strategy	Management and Strategy
N: Management Control, Accounting and Finance	Management Control, Accounting and Finance

Appendix IV. Types of Courses

Pursuant to § 4 (1) of the Excerpt of Statutes of Graz University of Technology, Legal Regulations for Academic Affairs, the following types of courses are offered at Graz University of Technology. The courses specified in number 2) to number 12) are courses with continuous assessment.

1) VO … lecture: Lectures introduce sections of the subject and its methods in a didactically well-prepared way. The contents and methods of a subject are presented.
2) UE … exercise: In exercises, the students' skills for applications of the subject to concrete problems are developed.
3) KU … design exercise: In design exercises skills and abilities are imparted and applied, experimentally or constructively in order to deepen and/or widen the material taught in the corresponding lectures in accordance with scientific vocational education. Special equipment or a special spatial equipment is required.
4) LU … laboratory course: In laboratory courses skills and abilities in the context of scientific vocational training with particularly intensive supervision are imparted in practical, experimental and/or constructive work in order to deepen and/or widen the material taught in the respective lectures. The preparation of protocols is included as an essential part of laboratory courses.
5) PT … project: In projects, experimental, theoretical and/or constructive, applied work or small-scale research work is carried out taking into account all necessary work steps. Projects are completed with written work that forms part of the assessment. Projects can be carried out as a team work or as individual work – in a team work, the individual performance must remain assessable.
6) VU … lecture with integrated exercises: In addition to the introduction in sections of the subject and its methods, lectures with integrated exercises (VU) offer instructions for independent knowledge acquisition or independent application in examples.
7) SE … seminar: Seminars serve to present scientific methods, to develop and critically evaluate own work results, special chapters of the scientific literature and to practice the expert discussion. Papers are written, presented and discussed.

8) SP … seminar project: In seminar projects, scientific methods are used to deal with experimental, theoretical and/or constructive applied problems and small research projects are carried out, taking into account all necessary work steps. Seminar projects are completed with a written paper and an oral presentation that forms part of the assessment. Seminar projects can be carried out as a team work or as individual work, whereby the individual performance must remain assessable in a team work.
9) EX … excursion: Excursions by means of their practical relevance serve to illustrate contents developed in other types of courses.
10) OL … orientation course: Orientation courses serve as an information opportunity and should provide an overview of the curriculum.
11) PV … exclusive tutorial: The exclusive tutorial is a research seminar within the scope of the doctoral programme.
12) FU … field exercises: Field exercises take place outside the premises of TU Graz in the open air (e.g. on the street, on construction sites, in alpine terrain, in forests, in tunnels) and partly in inclement weather conditions. The students carry out the exercises essentially independently after appropriate preparation.
13) KV … supplementary tutorial: Supplementary tutorials support other courses by offering a forum for students to discuss their questions and for the exemplary review of basic concepts.