

Curriculum for the Master's Degree Programme

Information and Computer Engineering

Curriculum 2025

This curriculum was approved by the Senate of Graz University of Technology during its meeting on June 23, 2025.

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 Subject matter of the degree programme and qualification profile

The Master's Degree Programme Information and Computer Engineering is an engineering degree. Graduates of this degree programme are awarded the academic degree "Diplom-Ingenieurin" or "Diplom-Ingenieur," abbreviated as "Dipl.-Ing." or "DI." The international equivalent of this university degree is "Master of Science," abbreviated as "MSc."

The Master's Degree Programme Information and Computer Engineering is provided as a foreign-language degree programme in English.

(1) Subject matter of the degree programme

The Master's Degree Programme Information and Computer Engineering teaches advanced subject knowledge, theories, methods, and applications in the two major areas of computer science and electrical engineering. Students can select their own specialisation in the master's degree programme with a major (primary specialisation) and a minor (secondary specialisation) in the following areas of computer science and electrical engineering:

- Artificial Intelligence
- Communications and Mobile Computing
- Embedded and Automotive Systems
- Information Security
- Microelectronics and IC Design
- Robotics
- Sensing and Control Systems
- Signal Processing and Human Communication
- Software Technology
- Visual Computing
- Business, Law, and Management (can only be chosen as a minor)

The Master's Degree Programme Information and Computer Engineering is designed to give students considerable freedom in choosing their desired course content and thus prepares them to think, decide and act independently and proactively in the rapidly changing field of information and computer engineering. The degree programme offers a unique, integrated education in the two major subject areas of computer science and electrical engineering. Careful attention is paid to maintaining a balance between these two subject areas when selecting the course content.

(2) Qualification profile and competences

Graduates of the Master's Degree Programme Information and Computer Engineering have the following knowledge, skills and competencies:

Knowledge and understanding

Graduates

- have in-depth and expanded subject-specific knowledge in the selected areas of computer science and electrical engineering.

- have fundamental knowledge that allows them to develop and/or apply ideas, often in a research context.
- can define and interpret the characteristics, limitations, terminologies, and schools of thought of computer science and electrical engineering.

Application of knowledge

Graduates

- can apply complex scientific methods in computer science and electrical engineering.
- can independently work on scientific and engineering tasks in the fields of computer science and electrical engineering.
- can apply their knowledge and problem-solving abilities in new and unfamiliar situations.

Evaluation and assessment

Graduates

- are able to handle complex situations in the fields of computer science and electrical engineering.
- can reason scientifically sound opinions in the fields of computer science and electrical engineering, including taking account of incomplete or limited information.
- are able to contribute to the discussion of societal, social and ethical implications based on their professional skills.

Communicative and social skills

Graduates

- have mastered communication and presentation techniques and can use them appropriately.
- are able to write technical documentation as well as scientific and academic texts.
- can communicate information, ideas, problems and their solutions clearly and unambiguously to an audience of both specialists and non-specialists.
- are flexible, able to adapt and can work in a team, particularly in interdisciplinary and English-speaking environments.

Organisational skills

Graduates

- can use learning strategies that enable them to further develop their knowledge independently.
- are able to work independently or in teams, motivating themselves and others.
- can take initiative and lead project groups and organisational units.

(3) Need and relevance of the degree programme for science and the labour market

The Master's Degree Programme Information and Computer Engineering provides a unique, in-depth education in the two major subject areas of computer science and electrical engineering, with the goal of empowering students to think, decide and act in an interdisciplinary manner. Graduates have a unique ability to look at information and computer systems integratively, which represent an essential foundation for business and society. Consequently, graduates are well prepared for a wide variety of career fields. The master's degree programme also provides students

with the skills required for independent scientific work within the framework of a doctoral programme. Furthermore, the in-depth training in computer science and electrical engineering opens up career opportunities for graduates in many areas of information and computer engineering. Graduates of this degree programme are sought after in virtually all fields of work, as digitalisation and automation are constantly advancing in all branches of industry, services, and public administration, and they are trained precisely for this growth area with regard to hardware and software. In particular, graduates of the degree programme are qualified for leading professional positions in these fields.

The skills acquired during the degree programme allow graduates to design innovative solutions for global challenges and sustainable development (Sustainable Development Goals) – including decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9), and climate action (SDG 13). They have the knowledge and skills to use digital technologies responsibly and in a future-oriented manner.

§ 2 Admission requirements

- (1) The Master's Degree Programme Information and Computer Engineering builds upon the content of the Bachelor's Degree Programme Information and Computer Engineering of Graz University of Technology. Graduates of this bachelor's degree thus meet the admission requirements for the Master's Degree Programme Information and Computer Engineering. Furthermore, the following degree programmes are eligible for admission to the Master's Degree Programme Information and Computer Engineering without further requirements:
 - a. Bachelor's Degree Programme Digital Engineering at TU Graz, Bachelor's Degree Programme Information Technology at the University of Klagenfurt, Bachelor's Degree Programme Robotics and Artificial Intelligence at the University of Klagenfurt, and Bachelor's Degree Programme Electronics and Information Technology at JKU Linz.
 - b. Any bachelor's degree programmes in computer science, software engineering and management, applied computer science, business informatics, software and information engineering, computer engineering, artificial intelligence, media computer science and visual computing or medical computer science at another Austrian university. In such cases, the Bridge Module "BR_EEE: Bridge – Electrical Engineering" must be completed instead of the module "X_ELECT: Cross-Catalogue Elective Courses" (see § 3 or § 7).
 - c. Any bachelor's degree programme in computer science or software engineering completed at a university in one of the following countries: Belgium, Bulgaria, Denmark, Germany, Estonia, Finland, France, Greece, Ireland, Italy, Iceland, Croatia, Latvia, Lichtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Switzerland, Slovakia, Slovenia, Spain, the Czech Republic, Hungary, the United Kingdom and Cyprus. In such cases, the Bridge Module "BR_EEE: Bridge – Electrical Engineering" must be completed instead of the module "X_ELECT: Cross-Catalogue Elective Courses" (see § 3 or § 7).
 - d. Any bachelor's degree programmes in electrical and electronics engineering, electrical engineering and sound engineering, biomedical engineering, mechatronics, electrical engineering and information technology, and electrical engineering at another Austrian university. In such cases, the Bridge Module "BR_CS: Bridge – Computer Science" must be completed instead of the module "X_ELECT: Cross-Catalogue Elective Courses" (see § 3 or § 7).
 - e. Any bachelor's degree programme in electrical engineering completed at a university in one of the following countries: Belgium, Bulgaria, Denmark, Germany, Estonia, Finland, France, Greece, Ireland, Italy, Iceland, Croatia, Latvia, Lichtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Switzerland, Slovakia, Slovenia, Spain, the Czech Republic, Hungary, the United Kingdom and Cyprus. In such cases, the

Bridge Module “BR_CS: Bridge – Computer Science” must be completed instead of the module “X_ELECT: Cross-Catalogue Elective Courses” (see § 3 or § 7).

- (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 mathematics, electrical engineering and computer science, specifically:
 - a. 20 ECTS credit points from courses on mathematics
 - b. 30 ECTS credit points from courses on electrical engineering
 - c. 30 ECTS credit points from courses on 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 Information and Computer Engineering 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 Structure of the degree programme

- (1) The Master’s Degree Programme Information and Computer Engineering with a total workload of 120 ECTS credit points comprises four semesters and is structured into modules as follows:

	ECTS
Major:	
Compulsory Module MA_COMP: Subject-Specific Major Compulsory Module	13.5–20
Elective Module MA_ELECT: Subject-Specific Major Elective Module	20–26.5
Total Major:	40
Minor:	
Elective Module MI: Subject-Specific Minor Compulsory Module	20
Elective Module X_ELECT: Cross-Catalogue Elective Courses	14
Elective Module SP: Seminar/Project	10
Free-choice courses	6
Master’s thesis	30
Total	120

- (2) For the master's degree programme, students must select a major as well as a minor, which must be different from the major, from the following list of subject areas:
- Artificial Intelligence (AI)
 - Communications and Mobile Computing (CMC)
 - Embedded and Automotive Systems (EAS)
 - Information Security (ISEC)
 - Microelectronics and IC Design (ME)
 - Robotics (RO)
 - Sensing and Control Systems (SCS)
 - Signal Processing and Human Communication (SPHC)
 - Software Technology (SWT)
 - Visual Computing (VC)
 - Business, Law, and Management (BLM) – can only be chosen as a minor
 - An individual specialisation is only possible for the major and requires approval by the officer responsible for study matters.

The choice of specialisation for the major determines which subject-specific compulsory module (MA_COMP) and which subject-specific elective module (MA_ELECT) must be completed. For example, if a student chooses the specialisation Information Security as their major, the subject-specific compulsory module (MA_COMP_ISEC: "Major Information Security – Compulsory Courses") and the corresponding subject-specific elective module (MA_ELECT_ISEC: "Major Information Security – Elective Courses") must be completed.

The choice of specialisation for the minor determines which subject-specific elective module (MI) must be completed. For example, if a student chooses the specialisation Visual Computing as their minor, the corresponding subject-specific elective module (MI_VC: "Minor Visual Computing") must be completed.

- (3) In order to ensure that a bachelor's degree programme and subsequent subject-related master's degree programme combined comprise a total workload of 300 ECTS credit points, one and the same course cannot be recognised for both the bachelor's degree programme qualifying the student for admission to a master's degree programme, and the master's degree programme in question.
- (4) Compulsory Module MA_COMP and Elective Module MA_ELECT vary in scope depending on the selected major. The differences for Compulsory Module MA_COMP depending on the selected major are outlined in § 6. The corresponding differences for Elective Module MA_ELECT are defined in § 7. Within these modules, courses can be selected in accordance with § 6 and § 7. The sum of ECTS credit points completed from Compulsory Module MA_COMP and Elective Module MA_ELECT must total at least 40 ECTS credit points. If more ECTS credit points are completed in Compulsory Module MA_COMP than the minimum sum specified in § 6 of the respective module description, the additional ECTS credit points can be recognised for Elective Module MA_ELECT.
- (5) For Elective Module MI, courses totalling at least 20 ECTS credit points must be completed in accordance with § 7. The subject area chosen as a minor must not be the same as the subject

area of the major. The subject area Business, Law, and Management (BLM) can only be chosen as a minor.

- (6) If more than 40 ECTS credit points are completed for the major (sum of Compulsory Module MA_COMP and Elective Module MA_ELECT) or more than 20 ECTS credit points are completed for the minor (Elective Module MI), any additional ECTS credit points can be recognised for Elective Module X_ELECT. It is not possible to recognise excess ECTS credit points for a bridge module.
- (7) If a student is admitted to the Master's Degree Programme Information and Computer Engineering according to § 2 (1) b–e of this curriculum, the corresponding bridge module (in acc. with § 7) must be completed instead of Elective Module X_ELECT. If the bridge module has fewer than 14 ECTS credit points, the total of ECTS credit points to be completed as free-choice courses increases by this difference.
- (8) If more than 74 ECTS credit points are completed for the modules MA_COMP, MA_ELECT, MI, and X_ELECT, the additional ECTS credit points can be recognised as free-choice courses.
- (9) For Elective Module SP, students must select a course according to the Elective Module Catalogue Seminar/Project in § 7.
- (10) The Master's Degree Programme Information and Computer Engineering is an interdisciplinary degree programme between the Faculty of Computer Science and Biomedical Engineering and the Faculty of Electrical and Information Engineering. Therefore, the selected subjects must be balanced in the master's degree programme according to the following balance criterion:

The courses for the master's degree programme must be selected in such a way that at least 18 ECTS credit points are completed at each of the two faculties.

A list of which courses are assigned to which faculty is available in § 7 of this curriculum. Courses not assigned to either faculty according to § 7 cannot be considered for fulfilling the balance criterion. The master's thesis also does not count towards the balance criterion.

Students must consider the balance criterion when planning their studies. This is particularly important if the chosen minor in Business, Law, and Management, as the courses of this minor are not assigned to either of the two faculties. In this case, the minimum of 18 ECTS credit points per faculty must be ensured by selecting courses in the modules MA_COMP, MA_ELECT, X_ELECT, SP, or free-choice courses accordingly.

§ 4 Group sizes

The following maximum numbers of participants (group sizes) have been established:

Lecture (VO) Lecture part of lecture with integrated exercises (VU)	no restriction
Exercise (UE) Exercise part of lecture with integrated exercises (VU) Design exercise (KU)	25
Laboratory course (LU)	6
Seminar (SE) Project (PT) Seminar project (SP)	20

§ 5 Guidelines for the allocation of places in courses

- (1) If the number of students exceeds the number of available places, students are allocated places on a course according to the following priority criteria, with the individual criteria being applied in the order given:
 - a. Position of the course in the curriculum (acc. to § 6 and § 7): Priority is given to students for whom the course is compulsory according to their curriculum over those who are taking the course as part of an elective module or free-choice subject.
 - b. Total of completed/recognised ECTS credit points for the degree programme: All study achievements completed in the degree programme for which the student wants to take the course are taken into account for the ranking. Students with the highest total of ECTS credit points already completed in their current degree programme are ranked preferentially.
 - c. Number of semesters spent studying the degree programme so far: Students are ranked according to the number of semesters they have already studied in the degree programme. Priority is given to those who have studied for longer.
 - d. Decision by lot: If it is not possible to rank students according to the above criteria, admission to the course is decided by lot.

- (2) Up to 10% of the existing places on the course are reserved for students completing part of their studies at TU Graz as part of a mobility programme.

II. Degree Programme Content and Structure

§ 6 Modules, courses and semester assignment

The individual courses of this master's degree programme and their designation as compulsory and elective modules are set out below. The knowledge, methods, or skills to be provided in the modules are described in more detail in Appendix I.

The chosen major determines the primary specialisation of the master's degree programme. The following tables outline the course content for the 10 possible major subject areas. Furthermore, the option of an individual major is defined.

The workload of courses of the type VU in § 6 and § 7 is generally subdivided into 0.5 semester course hours (SSt) lecture part and 0.5 SSt exercise part for a course listed as 1 SSt; 1 SSt lecture part and 1 SSt exercise part for a course listed as 2 SSt; 2 SSt lecture part and 1 SSt exercise part for a course listed as 3 SSt; and 2 SSt lecture part and 2 SSt exercise part for a course listed as 4 SSt. The following exceptions apply:

Lectures with integrated exercises (VU) with a lecture-exercise-split that deviates from the norm		
Course	SSt	Split
Advanced Analog IC Design 1	3	1.5/3 semester course hours lecture part, 1.5/3 semester course hours exercise part.
Advanced Analog IC Design 2	3	1.5/3 semester course hours lecture part, 1.5/3 semester course hours exercise part.
Analog RF Filter Design	2	1.5/2 semester course hours lecture part, 0.5/2 semester course hours exercise part.
Applied RF Measurement Techniques	2	1.4/2 semester course hours lecture part, 0.6/2 semester course hours exercise part.
Augmented Reality	3	1.5/3 semester course hours lecture part, 1.5/3 semester course hours exercise part.
Camera Drones	3	1/3 semester course hours lecture part, 2/3 semester course hours exercise part.
Communication Networks	2	1.5/2 semester course hours lecture part, 0.5/2 semester course hours exercise part.
Embedded Internet	2	1.5/2 semester course hours lecture part, 0.5/2 semester course hours exercise part.
Fundamentals of Geometry Processing	3	1/3 semester course hours lecture part, 2/3 semester course hours exercise part.
Fundamentals of RF Measurement Techniques	2	1.4/2 semester course hours lecture part, 0.6/2 semester course hours exercise part.
Integrated Navigation	2	1.33/2 semester course hours lecture part, 0.67/2 semester course hours exercise part.
Knowledge Discovery and Data Mining 2	3	1.5/3 semester course hours lecture part, 1.5/3 semester course hours exercise part.
Natural Language Processing	3	1.5/3 semester course hours lecture part, 1.5/3 semester course hours exercise part.
Navigation Systems	2	1.33/2 semester course hours lecture part, 0.67/2 semester course hours exercise part.
Sensor Networks	2	1.5/2 semester course hours lecture part, 0.5/2 semester course hours exercise part.

Major in Artificial Intelligence

Master's Degree Programme Information and Computer Engineering							
Major Artificial Intelligence (AI)							
Course	SSt	Type	ECTS	Semester with ECTS credit points			
				I	II	III	IV
Compulsory Module MA_COMP_AI: Major Artificial Intelligence (AI) - Compulsory Courses							
Knowledge Discovery and Data Mining 1	2	VO	3		3		
Knowledge Discovery and Data Mining 1	1	KU	1.5		1.5		
Machine Learning 2	2	VO	3		3		
Machine Learning 2	1	KU	2		2		
Deep Learning	2	VO	3	3			
Deep Learning	1	KU	2	2			
Probabilistic Decision Making	3	VU	5	5			
Total Compulsory Module	12		19.5	10	9.5		
Elective Module MA_ELECT_AI: Major Artificial Intelligence (AI) - Elective Courses			20.5				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			64.5				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Communications and Mobile Computing

Master's Degree Programme Information and Computer Engineering Major Communications and Mobile Computing (CMC)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_CMC: Major Communications and Mobile Computing (CMC) - Compulsory Courses							
Mobile Computing, Seminar	3	SE	4.5		4.5		
Courses totalling at least 9 ECTS credit points must be chosen from the following list:							
Advanced Digital Communications	2	VO	3	3			
Advanced Digital Communications	1	UE	1.5	1.5			
Information Theory and Coding	2	VO	3	3			
Information Theory and Coding	1	UE	1.5	1.5			
Context-Aware Computing	2	VO	3	3			
Context-Aware Computing	1	UE	1.5	1.5			
Communication Networks	2	VU	3		3		
Embedded Internet	2	VU	3	3			
Electromagnetic Fields I	2	VO	3		3		
Electromagnetic Fields I	2	UE	3		3		
Antennas and Wave Propagation	2	VO	3	3			
Antennas and Wave Propagation	1	UE	1.5	1.5			
Total Compulsory Module			13.5				
MA_ELECT_CMC: Major Communications and Mobile Computing (CMC) - Elective Courses			26.5				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			70.5				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Embedded and Automotive Systems

Master's Degree Programme Information and Computer Engineering Major Embedded and Automotive Systems (EAS)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_EAS: Major Embedded and Automotive Systems (EAS) - Compulsory Courses							
Embedded Systems	2	VO	3		3		
Embedded Systems, Laboratory	1	LU	1.5		1.5		
Real-Time Operating Systems	2	VO	3		3		
Real-Time Operating Systems, Laboratory	3	LU	4.5		4.5		
Courses totalling at least 7.5 ECTS credit points must be chosen from the following list (courses marked with * or + can only be chosen together):							
Automotive Electronics (*)	2	VO	3		3		
Automotive Electronics, Laboratory (*)	2	LU	3		3		
Design of Real-Time Systems, Laboratory	2	LU	3	3			
Embedded Automotive Software	2	VU	3	3			
Distributed Embedded Systems, Seminar	3	SE	4.5	4.5			
Real-Time Bus Systems (+)	1	VO	1.5	1.5			
Real-Time Bus Systems, Laboratory (+)	1	LU	1.5	1.5			
Automotive Engineering for Electrical, Information and Computer Engineering	2	VO	3	3			
Total Compulsory Module			19.5				
Elective Module MA_ELECT_EAS: Major Embedded and Automotive Systems (EAS) - Elective Courses			20.5				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			64.5				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Information Security

Master's Degree Programme Information and Computer Engineering							
Major Information Security (ISEC)							
Course	SSt	Type	ECTS	Semester with ECTS credit points			
				I	II	III	IV
Compulsory Module MA_COMP_ISEC: Major Information Security (ISEC) - Compulsory Courses							
Secure Software Development	3	VU	5	5			
Cryptography	2	VO	3	3			
Cryptography	1	KU	2	2			
Verification and Model Checking	3	VU	5		5		
Secure Application Design	2	VO	3		3		
Secure Application Design	1	KU	2		2		
Total Compulsory Module	12		20	10	10		
Elective Module MA_ELECT_ISEC: Major Information Security (ISEC) - Elective Courses			20				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			64				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Microelectronics and IC Design

Master's Degree Programme Information and Computer Engineering							
Major Microelectronics and IC Design (ME)							
Course	SSt	Type	ECTS	Semester with ECTS credit points			
				I	II	III	IV
Compulsory Module MA_COMP_ME: Major Microelectronics and IC Design (ME) - Compulsory Courses							
Fundamentals of Microelectronics	2	VO	3	3			
Analog IC Design 1	2	VO	3	3			
Analog IC Design 1	2	UE	3	3			
Hardware Design for Security	2	VU	5		5		
Courses totalling at least 5 ECTS credit points must be chosen from the following list (courses marked with *, + or # can only be chosen together):							
IC Design Fundamentals (*)	2	VO	3	3			
IC Design Fundamentals (*)	2	UE	3	3			
Analog IC Design 2 (+)	2	VO	3		3		
Analog IC Design 2 (+)	2	UE	3		3		
Fundamentals of RF & Microwave Engineering (#)	2	VO	3	3			
Fundamentals of RF & Microwave Engineering (#)	1	UE	2	2			
Total Compulsory Module			19				
Elective Module MA_ELECT_ME: Major Microelectronics and IC Design (ME) - Elective Courses			21				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			65				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Robotics

Master's Degree Programme Information and Computer Engineering Major Robotics (RO)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_RO: Major Robotics (RO) - Compulsory Courses							
Advanced Robotics	2	VO	3		3		
Advanced Robotics	1	LU	2		2		
Mobile Robots	2	VO	3	3			
Mobile Robots	1	UE	2	2			
Robot Vision	2	VO	3		3		
Robot Vision	1	KU	2		2		
Total Compulsory Module	9		15	5	10		
Elective Module MA_ELECT_RO: Major Robotics (RO) - Elective Courses			25				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			69				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Sensing and Control Systems

Master's Degree Programme Information and Computer Engineering Major Sensing and Control Systems (SCS)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_SCS: Major Sensing and Control Systems (SCS) - Compulsory Courses							
State Estimation and Filtering	2	VO	3	3			
State Estimation and Filtering	1	UE	1.5	1.5			
Discrete-Time Control	2	VO	3	3			
Discrete-Time Control, Laboratory	1	LU	1.5	1.5			
Signal Analysis	2	VO	3	3			
Signal Analysis	1	UE	1.5	1.5			
Total Compulsory Module	9		13.5	13.5			
Elective Module MA_ELECT_SCS: Major Sensing and Control Systems (SCS) - Elective Courses			26.5				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			70.5				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Signal Processing and Human Communication

Master's Degree Programme Information and Computer Engineering Major Signal Processing and Human Communication (SPHC)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_SPHC: Major Signal Processing and Human Communication (SPHC) - Compulsory Courses							
Adaptive Systems	2	VO	3	3			
Adaptive Systems	1	UE	1.5	1.5			
Signal Analysis	2	VO	3	3			
Signal Analysis	1	VO	1.5	1.5			
Courses totalling at least 6 ECTS credit points must be chosen from the following list (courses marked with *, + or # can only be chosen together):							
Speaking and Listening Machines, Laboratory (*)	2	LU	3		3		
Speech Signal Processing (*)	2	VO	3	3			
Digital Audio Engineering (+)	2	VO	3	3			
Psychoacoustics 01 (+)	2	VO	3		3		
Non-Invasive Brain Computer Interfaces (#)	2	VO	3		3		
Non-Invasive Brain Computer Interfaces (#)	2	KU	3		3		
Total Compulsory Module			15				
Elective Module MA_ELECT_SPHC: Major Signal Processing and Human Communication (SPHC) - Elective Courses			25				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			69				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Software Technology

Master's Degree Programme Information and Computer Engineering Major Software Technology (SWT)				Semester with ECTS credit points			
Course	SSt	Type	ECTS	I	II	III	IV
Compulsory Module MA_COMP_SWT: Major Software Technology (SWT) - Compulsory Courses							
Software Technology	3	VU	5		5		
Compiler Construction	2	VO	3		3		
Compiler Construction	1	KU	2		2		
Courses totalling at least 5.5 ECTS credit points must be chosen from the following list (courses marked with * can only be chosen together):							
Agile Software Development	3	VU	4		4		
Basics in Artificial Intelligence and Logic	2	VU	3		3		
Modelling Technical Systems (*)	2	VO	3	3			
Modelling Technical Systems (*)	1	KU	2	2			
Quality Assurance in Software Development	2	VU	2.5		2.5		
Total Compulsory Module			15.5				
Elective Module MA_ELECT_SWT: Major Software Technology (SWT) - Elective Courses			24.5				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			68.5				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Major in Visual Computing

Master's Degree Programme Information and Computer Engineering							
Major Visual Computing (VC)							
Course	SSt	Type	ECTS	Semester with ECTS credit points			
				I	II	III	IV
Compulsory Module MA_COMP_VC: Major Visual Computing (VC) - Compulsory Courses							
Real-Time Graphics	2	VO	3	3			
Real-Time Graphics	1	KU	2	2			
Robot Vision	2	VO	3		3		
Robot Vision	1	KU	2		2		
Image Processing and Pattern Recognition	2	VO	3	3			
Image Processing and Pattern Recognition	1	KU	2	2			
Virtual Reality	3	VU	5		5		
Total Compulsory Module	12		20	10	10		
Elective Module MA_ELECT_VC: Major Visual Computing (VC) - Elective Courses			20				
Minor Elective Module for the chosen minor			20				
Elective Module SP: Seminar/Project			10				
Elective Module X_ELECT: Cross-Catalogue Elective Courses			14				
Total Elective Modules acc. to § 7			64				
Master's thesis			30				
Free-choice subjects acc. to § 8			6				
Overall total			120	30	30	30	30

Individual major

Students can create an individual major from courses available in the catalogue of electives in § 7. To do so, the student must submit a proposed list of courses from Compulsory Module MA_COMP and Elective Module MA_ELECT totalling 40 ECTS credit points, a proposed name for the individual major, and a letter of motivation to the officer responsible for study matters. The subject focus of the individual major must differ from all existing majors by at least 20 ECTS credit points. The officer responsible for study matters then decides on the proposal. If approved, all courses selected from Compulsory Module MA_COMP and Elective Module MA_ELECT for the individual major must be completed.

§ 7 Elective modules

- (1) For the subject-specific elective module of the major (Elective Module MA_ELECT), courses must be completed from the elective module catalogue of the respective subject area of the major. The scope of the subject-specific elective module MA_ELECT is defined in § 6 as well as at the beginning of each elective module catalogue in § 7 for each subject area.

In the following elective module catalogues, courses that are either compulsory or compulsory elective courses as part of the subject-specific compulsory modules MA_COMP are marked in the column “Major.” Courses required for Compulsory Module MA_COMP are marked with an “x” in the column “Major.” Courses marked with “*” are compulsory elective courses. These markings correspond to the descriptions of Compulsory Modules MA_COMP for the various subject areas in § 6. Compulsory elective courses that are not completed as part of Compulsory Module MA_COMP can be completed as part of Elective Module MA_ELECT.

- (2) For the minor (Elective Module MI), courses totalling 20 ECTS credit points must be completed from the elective module catalogue of the chosen subject area. Courses required for the respective Elective Module MI are marked with an “x” in the column “Minor” in each elective module catalogue. Courses marked with “*” are compulsory elective courses. The scope of compulsory elective courses to be completed is specified for each elective module catalogue.
- (3) For Elective Module X_ELECT, courses totalling 14 ECTS credit points must be completed. For completion of Elective Module X_ELECT, courses can be selected from all elective module catalogues listed in § 7, except those from the Elective Module Catalogue SP and those from Bridge Modules BR_CS and BR_EEE.
- (4) For completion of Elective Module SP, one course must be selected from the Elective Module Catalogue SP. This course must correspond to the subject area of either the major or the minor.
- (5) Courses with the title “Selected Topics of [Elective Module Catalogue Name] (Subtitle)” are assigned to the corresponding elective module catalogues, with one semester hour per week generally corresponding 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) or 2–3 semester course hours for seminars (SE). Courses with different subtitles should be evaluated as different courses.
- (6) The allocation of all courses to the respective faculties is shown in the first column of the following tables as a guide to fulfilling the balance criterion pursuant to § 3 (10). Courses from the Faculty of Computer Science and Biomedical Engineering are marked with “C.” Courses from the Faculty of Electrical and Information Engineering are marked with “E.” Courses without a “C” or “E” are not assigned to either faculty.

Elective Module Catalogue Artificial Intelligence

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_AI (19.5 ECTS):** Compulsory subjects marked with (x) in the “Major” column must be considered when selecting courses for this module.
- **MA_ELECT_AI (20.5 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_AI (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Artificial Intelligence (AI)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area AI Architectures and Foundations								
C	Artificial Intelligence 2	2	VU	3		x		
C	Principles of Brain Computation	2	VO	3		x		
C	Principles of Brain Computation	1	KU	2		x		
C	Nonlinear Optimisation	3	VO	4.5	x			
C	Nonlinear Optimisation	2	UE	2.5	x			
E	Nonlinear Signal Processing	2	VO	3	x			
E	Nonlinear Signal Processing	1	UE	1.5	x			
E	Adaptive Systems	2	VO	3	x			
E	Adaptive Systems	1	UE	1.5	x			
Focus Area Data Science								
C	Knowledge Discovery and Data Mining 1	2	VO	3		x	x	x
C	Knowledge Discovery and Data Mining 1	1	KU	1.5		x	x	x
C	Information Search and Retrieval	3	VU	5	x			
	Data Analysis and Introduction to R	2	VO	3	x			
	Data Analysis and Introduction to R	1	UE	2	x			
C	Knowledge Discovery and Data Mining 2	3	VU	5	x			
Focus Area Machine Learning								
C	Machine Learning 2	2	VO	3		x	x	
C	Machine Learning 2	1	KU	2		x	x	
C	Deep Learning	2	VO	3	x		x	x
C	Deep Learning	1	KU	2	x		x	x
E	Probabilistic Machine Learning	2	VO	3	x			
E	Probabilistic Machine Learning	1	KU	1.5	x			
C	Probabilistic Decision Making	3	VU	5	x		x	
E	Hybrid Modelling and Domain-Aware Machine Learning	2	VU	3	x			
Focus Area AI Technologies								
C	Advanced Topics in Artificial Intelligence	2	VO	3	x			
C	Advanced Topics in Artificial Intelligence	1	UE	2	x			
E	Embedded Machine Learning	2	VU	3	x			

Elective Module Catalogue Artificial Intelligence (AI)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
C Advanced Information Retrieval	3	VU	5	x				
C Image and Video Understanding	2	VO	3	x				
C Image and Video Understanding	1	KU	2	x				
Focus Area Language and Interaction								
C Natural Language Processing	3	VU	5		x			
C Social Media Technologies	2	VU	3		x			
E Spoken Language in Human and Human-Computer Dialogue	2	VU	3		x			
E Automatic Speech Recognition	2	VO	3	x				
C Explanations in Artificial Intelligence	2	VU	3		x			
E Signal Processing and Machine Learning 1, Seminar	2	SE	3	x				
Focus Area Intelligent Systems								
C Intelligent Systems	2	VO	3		x			
C Intelligent Systems	1	KU	2		x			
C Recommender Systems	2	VU	3		x			
E Computational Intelligence	2	VO	3		x			
E Computational Intelligence	1	UE	1.5		x			

Elective Module Catalogue Communications and Mobile Computing

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_CMC (13.5 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 9 ECTS credit points must be selected.
- **MA_ELECT_CMC (26.5 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_CMC (20 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 4.5 ECTS credit points must be selected.

Elective Module Catalogue Communication and Mobile Computing (CMC)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Digital Communications								
E	Advanced Telecommunications, Laboratory	2	LU	3		x		
E	Advanced Digital Communications	2	VO	3	x		*	*
E	Advanced Digital Communications	1	UE	1.5	x		*	*
E	Information Theory and Coding	2	VO	3	x		*	*
E	Information Theory and Coding	1	UE	1.5	x		*	*
E	Modelling of Wireless Propagation Channels	2	VO	3		x		
E	Satellite Communications	2	VO	3	x			
E	Satellite Communications	1	UE	1.5	x			
E	Advanced Information Theory	2	VU	3		x		
Focus Area Microwave Engineering								
E	Guided Wave Propagation and Components	2	VO	3		x		
E	Guided Wave Propagation and Components	1	UE	1.5		x		
E	RF Systems, Laboratory	2	LU	3		x		
E	Optoelectrical Communication Engineering	3	VO	4.5	x			
E	Optoelectrical Communication Engineering	1	UE	1.5	x			
Focus Area Mobile Computing								
E	Context-Aware Computing	2	VO	3	x		*	*
E	Context-Aware Computing	1	UE	1.5	x		*	*
E	Mobile Computing, Laboratory	2	LU	3		x		
E	Mobile Computing, Seminar	3	SE	4.5		x	x	x
E	Power-Aware Computing	2	VU	3	x			
E	Power-Aware Computing, Laboratory	1	LU	1.5	x			
E	Computer Systems and Networks	2	VO	3	x			
E	Computer Systems and Networks	1	UE	1.5	x			
E	Smart Service Development	2	VO	3		x		
E	Smart Service Development	1	UE	1.5		x		
Focus Area Mobile Networks								
E	Communication Networks	2	VU	3		x	*	*

Elective Module Catalogue Communication and Mobile Computing (CMC)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
E Embedded Internet	2	VU	3	x		*	*	
E Embedded Internet, Laboratory	2	LU	3	x				
E Fault-Tolerant Distributed Algorithms	2	VU	3	x				
E Sensor Networks	2	VU	3		x			
E Sensor Networks, Laboratory	2	LU	3		x			
E Low-Power Wireless Localisation Systems	2	VU	3	x				
Focus Area Modelling, Simulation and Optimisation								
E Computational Electromagnetics	2	VO	3		x			
E Computational Electromagnetics	1	UE	1.5		x			
E Electromagnetic Fields I	2	VO	3		x	*	*	
E Electromagnetic Fields I	2	UE	3		x	*	*	
E Optimisation I	2	VU	3	x				
E Multiphysical Simulation I	2	VO	3	x				
E Multiphysical Simulation I	1	UE	1.5	x				
E Smart Antennas	2	VU	3		x			
E Advanced Electrodynamics, Laboratory	2	LU	3		x			
Focus Area Signal Processing								
E Adaptive Systems	2	VO	3	x				
E Adaptive Systems	1	UE	1.5	x				
E Estimation and Detection Theory for Communications	2	VO	3		x			
E Estimation and Detection Theory for Communications	1	UE	1.5		x			
E Bayesian Inference for Localisation, Sensing, and Communications	2	VU	3	x				
Focus Area Wireless Systems								
E Antennas and Wave Propagation	2	VO	3	x		*	*	
E Antennas and Wave Propagation	1	UE	1.5	x		*	*	
E RF System Design	2	VO	3		x			
E RF System Design	1	UE	1.5		x			
E Communication and Sensing Systems, Seminar	1.5	SE	2	x				
E Wireless Power Technologies for Sustainable Electronics	2	VO	3		x			
E Introduction to Radar Systems	2	VO	3	x				

Elective Module Catalogue Embedded and Automotive Systems

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_EAS (19.5 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 7.5 ECTS credit points must be selected. Connected rows must be selected in combination.
- **MA_ELECT_EAS(20,5 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_EAS (20 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 4.5 ECTS credit points must be selected. Connected rows must be selected in combination.

Elective Module Catalogue Embedded and Automotive Systems (EAS)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Electronics								
E Automotive Electronics	2	VO	3		x	*	*	
E Automotive Electronics, Laboratory	2	LU	3		x			
E Automotive Sensors and Actuators	2	VO	3		x			
E Automotive Sensors and Actuators, Laboratory	2	LU	3	x				
E Electromagnetic Compatibility of Electronic Systems	2	VO	3	x				
E Electromagnetic Compatibility of Electronic Systems, Laboratory	1	LU	1.5	x				
E Development of Electronic Systems	4	VO	6	x				
Focus Area Embedded Hardware								
E Embedded Systems	2	VO	3		x	x	x	
E Embedded Systems, Laboratory	1	LU	1.5		x	x	x	
E Processor Architecture	2	VO	3		x			
E Processor Architecture, Laboratory	1	LU	1.5		x			
E Microcontroller Design, Laboratory	4	LU	6		x			
E Hardware-Software Codesign	2	VO	3		x			
E Hardware-Software Codesign	1	UE	1.5		x			
E Design of Real-Time Systems, Laboratory	2	LU	3	x		*	*	
Focus Area Embedded Software								
E Microcontroller	1.5	VO	2	x				
E Microcontroller	2	UE	3	x				
E Real-Time Operating Systems	2	VO	3		x	x	*	
E Real-Time Operating Systems, Laboratory	3	LU	4.5		x	x		
E Embedded Automotive Software	2	VU	3	x		*	*	
E Distributed Embedded Systems, Seminar	3	SE	4.5	x		*	*	
E DSP Algorithms and Systems: A Practical Approach	3	VU	4.5					

Elective Module Catalogue Embedded and Automotive Systems (EAS)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Measurement and Engineering								
E	Automotive Engineering for Electrical, Information and Computer Engineering	2	VO	3	x		*	*
E	Automotive Measurement	2	VO	3		x		
E	Automotive Measurement, Laboratory	1	LU	1.5		x		
E	Vibrational Measurements	2	VO	3		x		
E	Vibrational Measurements, Laboratory	1	LU	1.5		x		
E	Introduction to Electric Drive Systems	2	VO	3		x		
E	Innovative Propulsion and Vehicle Concepts	2	VO	3		x		
Focus Area Automation, Control, and Communication								
E	Process Automation	2	VO	3		x		
E	Process Automation, Laboratory	2	LU	3		x		
E	Process Instrumentation	2	VO	3		x		
E	Process Instrumentation, Laboratory	1	LU	1.5		x		
E	Real-Time Bus Systems	1	VO	1.5	x		*	*
E	Real-Time Bus Systems, Laboratory	1	LU	1.5	x			
Focus Area Software Development and Services								
E	Industrial Software Development and Quality Management	2	VO	3		x		
E	Industrial Software Development and Quality Management	1	UE	1.5		x		
E	Smart Service Development	2	VO	3		x		
E	Smart Service Development	1	UE	1.5		x		
E	Design Patterns	2	VO	3	x			
E	Design Patterns	1	UE	1.5	x			
E	Fault-Tolerant Computing Systems	2	VO	3		x		
E	Fault-Tolerant Computing Systems	1	UE	1.5		x		

Elective Module Catalogue Information Security

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_ISEC (20 ECTS):** Compulsory subjects marked with (x) in the “Major” column must be considered when selecting courses for this module.
- **MA_ELECT_ISEC (20 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_ISEC (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Information Security (ISEC)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Secure Systems								
C Secure Software Development	3	VU	5	x		x	x	
C Pentesting Lab	3	VU	5		x			
C Side-Channel Security	3	VU	5		x			
C Hardware Design for Security	3	VU	5		x			
C Algorithms to Hardware using High-Level Synthesis	2	VU	3		x			
C Cryptography on Hardware Platforms	3	VU	5	x				
C Cryptography on Software Platforms	3	VU	5		x			
C Secure System Architectures	3	VU	5	x				
C Cloud Operating Systems	3	VU	5		x			
Focus Area Cryptology & Privacy								
C Cryptography	2	VO	3	x		x	x	
C Cryptography	1	KU	2	x		x	x	
C Cryptanalysis	3	VU	5		x			
C Privacy Enhancing Technologies	2	VO	3	x				
C Privacy Enhancing Technologies	1	KU	2	x				
C Modern Public Key Cryptography	3	VU	5		x			
C Mathematical Foundations of Cryptography	3	VU	5	x				
C Coding and Cryptography	3	VO	4.5		x			
C Coding and Cryptography	1	UE	1.5		x			
Focus Area Formal Methods								
C Verification and Model Checking	3	VU	5		x	x		
C Trustworthy Artificial Intelligence	3	VU	5		x			
C Model-Based Testing	3	VU	5	x				
C Formal Specification and Design of Software	3	VU	5	x				
C Logic and Computability	2	VO	3	x				
C Logic and Computability	2	KU	2	x				
Focus Area Secure Applications								
C Secure Application Design	2	VO	3		x	x		
C Secure Application Design	1	KU	2		x	x		
C Mobile Security	2	VO	3		x			

Elective Module Catalogue Information Security (ISEC)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
C Mobile Security	1	KU	2		x			
C Secure Product Lifecycle	2	VO	3	x				
C Secure Product Lifecycle	1	KU	2	x				

Elective Module Catalogue Microelectronics and IC Design

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_ME (19 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 5 ECTS credit points must be selected. Connected rows must be selected in combination.
- **MA_ELECT_ME (21 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_ME (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Microelectronics and IC Design (ME)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Microelectronics Fundamentals								
E Fundamentals of Microelectronics	2	VO	3	x		x	x	
E IC Design Fundamentals	2	VO	3	x		*		
E IC Design Fundamentals	2	UE	3	x				
E Practical Analog Circuit Design	2	UE	3		x			
E Practical Analog Circuit Design, Laboratory	1	LU	1		x			
E IC Design Project Management and Quality	1	VO	1.5		x			
E Physics of Semiconductor Devices	2	VO	3	x				
E Development of Electronic Systems	4	VO	6	x				
Focus Area Analog Design								
E Analog IC Design 1	2	VO	3	x		x	x	
E Analog IC Design 1	2	UE	3	x		x		
E Analog IC Design 2	2	VO	3		x	*		
E Analog IC Design 2	2	UE	3		x			
E Electronic Circuit Design 3	2	VO	3	x				
E Analog Circuit, Laboratory	3	LU	3		x			
Focus Area Digital Design								
C Hardware Design for Security	3	VU	5		x	x		
E Hardware Description Languages	2	VO	3	x				
E Hardware Description Languages	1	UE	1.5	x				
E Digital Circuit, Laboratory	3	LU	4	x				
Focus Area Analog Layout, Test and Verification								
E Analog IC Layout 1	2	UE	3		x			
E Advanced Layout Techniques	1	VU	1.5	x				
E Production Test and Design for Test	2	VO	3		x			
E Methods for IC Evaluation and Failure Analysis	2	VU	3	x				
E Evaluation of ICs, Laboratory	3	LU	4.5		x			

Elective Module Catalogue					Semester allocation		Compulsory	
Microelectronics and IC Design (ME)					WS	SS	Major	Minor
Course	SSt	Type	ECTS					
Focus Area Advanced Analog Design								
E	Advanced Analog IC Design 1	3	VU	4.5	x			
E	Advanced Analog IC Design 2	3	VU	4.5		x		
E	Noise and Crosstalk in ICs	2	VU	3		x		
E	Selected Topics of Electronics Systems and IC Design (Advanced Analog IC Design)	2	VO	3	x			
E	Smart Power and High Voltage Circuits	2	VO	3	x			
Focus Area Robust Design								
E	Electromagnetic Compatibility of Electronic Systems	2	VO	3	x			
E	Electromagnetic Compatibility of Electronic Systems, Laboratory	1	LU	1.5	x			
E	Electromagnetic Compatibility of ICs	1	VO	1.5		x		
E	Electromagnetic Compatibility of ICs, Laboratory	1	LU	1.5		x		
E	Reliable Integrated Circuits in Design and Application	1	VO	1.5		x		
E	Compact Modelling and Robust IC Design	1	VU	1.5		x		
E	Micro-Electromechanical Systems	2	VO	3	x			
Focus Area RF Design								
E	Fundamentals of RF & Microwave Engineering	2	VO	3	x		*	
E	Fundamentals of RF & Microwave Engineering	1	UE	1.5	x			
E	RF System Design	2	VO	3		x		
E	RF System Design	1	UE	1.5		x		
E	RF Systems, Laboratory	2	LU	3		x		
E	Fundamentals of RF Measurement Techniques	2	VU	3	x			
E	Applied RF Measurement Techniques	2	VU	3		x		
E	Analog RF Filter Design	2	VU	3	x			
E	Wireless Power Technologies for Sustainable Electronics	2	VO	3		x		
Focus Area Power Electronics								
E	Power Electronics	2	VO	3	x			
E	Power Electronics	1	UE	1.5	x			
E	Power Electronic Systems	2	VO	3	x			

Elective Module Catalogue Robotics

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_RO (15 ECTS):** Compulsory subjects marked with (x) in the “Major” column must be considered when selecting courses for this module.
- **MA_ELECT_RO (25 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_RO (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Robotics (RO)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Foundations								
C	Advanced Robotics	2	VO	3		x	x	x
C	Advanced Robotics	1	LU	2		x	x	x
C	Mobile Robots	2	VO	3	x		x	
C	Mobile Robots	1	UE	2	x		x	
E	State Estimation and Filtering	2	VO	3	x			
E	State Estimation and Filtering	1	UE	1.5	x			
	Kinematics and Robotics	2	VO	3		x		
	Kinematics and Robotics	1	KU	2		x		
Focus Area Perception								
C	Deep Learning	2	VO	3	x			
C	Deep Learning	1	KU	2	x			
C	Robot Vision	2	VO	3		x	x	x
C	Robot Vision	1	KU	2		x	x	x
C	Camera Drones	3	VU	5	x			
C	Multi-Modal Robot Perception	2	VU	3	x			
Focus Area State Estimation and Control								
E	Mechatronic Systems Modelling	2	VO	3		x		
E	Mechatronic Systems Modelling	1	UE	1.5		x		
E	Optimisation and Control	2	VO	3		x		
E	Optimisation and Control, Laboratory	1	LU	1.5		x		
E	Computer Aided Control System Design	2	VO	3	x			
E	Computer Aided Control System Design	1	UE	1.5	x			
E	Process Automation	2	VO	3		x		
E	Process Automation, Laboratory	2	LU	3		x		
Focus Area Deciding								
C	Intelligent Systems	2	VO	3		x		
C	Intelligent Systems	1	KU	2		x		
C	Probabilistic Decision Making	3	VU	5	x			
E	Computational Intelligence	2	VO	3		x		
E	Computational Intelligence	1	UE	1.5		x		

Elective Module Catalogue Robotics (RO)					Semester allocation		Compulsory	
					WS	SS	Major	Minor
Course	SSt	Type	ECTS					
Focus Area Interacting								
E	Context-Aware Computing	2	VO	3	x			
E	Context-Aware Computing	1	UE	1.5	x			
C	Designing Interactive Systems	2	VU	3		x		
C	Advanced Topics in Artificial Intelligence	2	VO	3	x			
C	Advanced Topics in Artificial Intelligence	1	UE	2	x			
Focus Area Acting and Navigation								
	Navigation Systems	2	VU	3	x			
	Integrated Navigation	2	VU	3		x		
E	Control of Electric Drives and Machines	2	VO	3	x			
E	Control of Electric Drives and Machines, Laboratory	2	LU	3	x			
	Industrial Robots	2	VU	2	x			
Focus Area Engineering								
C	Software Engineering for Autonomous Robots	2	VU	3	x			
	Design Thinking and Rapid Prototyping	3	LU	3	x			
C	Modelling Technical Systems	2	VO	3	x			
C	Modelling Technical Systems	1	KU	2	x			
E	Embedded Systems	2	VO	3		x		
E	Embedded Systems, Laboratory	1	LU	1.5		x		
C	Construction of Mobile Robots	2	PT	5	x			

Elective Module Catalogue Sensing and Control Systems

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_SCS (13.5 ECTS):** Compulsory subjects marked with (x) in the “Major” column must be considered when selecting courses for this module.
- **MA_ELECT_SCS (26.5 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_SCS (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Sensing and Control Systems (SCS)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Control Systems								
E	State Estimation and Filtering	2	VO	3	x		x	
E	State Estimation and Filtering	1	UE	1.5	x		x	
E	Discrete-Time Control	2	VO	3	x		x	x
E	Discrete-Time Control, Laboratory	1	LU	1.5	x		x	x
E	Process Automation	2	VO	3		x		
E	Process Automation, Laboratory	2	LU	3		x		
E	Automatic Control, Laboratory	1	LU	1.5	x			
Focus Area Advanced Control Concepts								
E	Advanced Control Concepts	2	VO	3		x		
E	Advanced Control Concepts	1	UE	1.5		x		
E	Computer Aided Control System Design	2	VO	3	x			
E	Computer Aided Control System Design	1	UE	1.5	x			
E	Control of Distributed Parameter Systems	2	VO	3		x		
E	Control of Distributed Parameter Systems	1	UE	1.5		x		
E	Multivariable Systems	2	VO	3		x		
E	Multivariable Systems	1	UE	1.5		x		
Focus Area Optimisation and Optimal Control								
E	Optimisation I	2	VU	3	x			
E	Optimisation and Control	2	VO	3		x		
E	Optimisation and Control, Laboratory	1	LU	1.5		x		
E	Optimal Feedback Design	2	VO	3		x		
E	Optimal Feedback Design	1	UE	1.5		x		
Focus Area Nonlinear and Adaptive Systems								
E	Adaptive Systems	2	VO	3	x			
E	Adaptive Systems	1	UE	1.5	x			
E	Nonlinear Signal Processing	2	VO	3	x			
E	Nonlinear Signal Processing	1	UE	1.5	x			
E	Nonlinear Control Systems, Basics	2	VO	3		x		
E	Nonlinear Control Systems	2	VO	3	x			
E	Nonlinear Control Systems	2	UE	3	x			

Elective Module Catalogue Sensing and Control Systems (SCS)					Semester allocation		Compulsory	
					WS	SS	Major	Minor
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Modelling and Electric Machines								
E	Computer Aided System Modelling	2	VO	3	x			
E	Computer Aided System Modelling	1	UE	1.5	x			
E	Hybrid Modelling and Domain-Aware Machine Learning	2	VU	3	x			
E	Mechatronic Systems Modelling	2	VO	3		x		
E	Mechatronic Systems Modelling	1	UE	1.5		x		
E	Similitude Theory and Scaling Laws	2	VO	3		x		
E	Control of Electric Drives and Machines	2	VO	3	x			
E	Control of Electric Drives and Machines, Laboratory	2	LU	3	x			
Focus Area Condition Monitoring								
E	Measurement Uncertainties	2	VU	3		x		
E	Signal Analysis	2	VO	3	x		x	
E	Signal Analysis	1	UE	1.5	x		x	
E	Multi-Sensor Data Fusion, Laboratory	1	LU	1.5	x			
E	Process Instrumentation	2	VO	3		x		
E	Process Instrumentation, Laboratory	1	LU	1.5		x		
Focus Area Sensors								
E	Fundamentals of Photonics	2	VO	3	x			
E	Fundamentals of Photonics, Laboratory	1	LU	1.5	x			
E	Physical Effects for Sensors	2	VO	3		x		
E	Physical Effects for Sensors	1	UE	1.5		x		
E	Advanced Electrodynamics, Laboratory	2	LU	3		x		
E	Environmental Sensing	2	VO	3	x			
E	Quantum Sensing and Measurement	2	VU	3		x		
Focus Area Measurement Systems								
E	Measurement Electronics	2	VO	3		x		
E	Energy Harvesting Systems	2	VO	3	x			
E	Automotive Measurement	2	VO	3		x		
E	Automotive Measurement, Laboratory	1	LU	1.5		x		
E	Electrical Measuring Instruments, Laboratory	1	LU	1.5		x		
E	Fundamentals of RF Measurement Techniques	2	VU	3		x		
E	Applied RF Measurement Techniques	2	VU	3	x			

Elective Module Catalogue Signal Processing and Human Communication

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_SPHC (15 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 6 ECTS credit points must be selected. Connected rows must be selected in combination.
- **MA_ELECT_SPHC (25 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_SPHC (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue								
Signal Processing and Human Communication (SPHC)								
Course	SSt	Type	ECTS	Semester allocation		Compulsory		
				WS	SS	Major	Minor	
Focus Area Signal Processing - Basic								
E	DSP Algorithms and Systems: A Practical Approach	3	VU	4.5		x		
E	Adaptive Systems	2	VO	3	x		x	x
E	Adaptive Systems	1	UE	1.5	x		x	x
E	Signal Analysis	2	VO	3	x		x	x
E	Signal Analysis	1	UE	1.5	x		x	x
Focus Area Signal Processing - Advanced								
E	Nonlinear Signal Processing	2	VO	3	x			
E	Nonlinear Signal Processing	1	UE	1.5	x			
E	Mixed-Signal Processing Systems Design	2	VU	3	x			
E	Advanced Information Theory	2	VU	3		x		
E	Signal Processing and Machine Learning 1 or 2	2	SE	3	x	x		
E	Estimation and Detection Theory for Communications	2	VO	3		x		
E	Estimation and Detection Theory for Communications	1	UE	1.5		x		
Focus Area Speech Communication - Basic								
E	Speaking and Listening Machines, Laboratory	2	LU	3		x	*	
E	Speech Signal Processing	2	VO	3	x			
E	Speech Signal Processing	1	UE	1.5	x			
E	Conversational Systems	1	VU	1.5	x			
E	Linguistic Foundations of Speech and Language Technology	2	VU	3	x			
E	Computational Intelligence	2	VO	3		x		
E	Computational Intelligence	1	UE	1.5		x		
Focus Area Speech Communication - Advanced								
E	Human Speech Production, Perception, and Pathologies	2	VU	3		x		
E	Spoken Language in Human and Human-Computer Dialogue	2	VU	3		x		
E	Natural Language Processing	3	VU	5		x		
E	Automatic Speech Recognition	2	VO	3	x			

Elective Module Catalogue								
Signal Processing and Human Communication (SPHC)								
Course	SSt	Type	ECTS	Semester allocation		Compulsory		
				WS	SS	Major	Minor	
E Speech Synthesis	2	VU	3		x			
Focus Area Audio Communication								
E Digital Audio Engineering	2	VO	3	x		*		
E Psychoacoustics 01	2	VO	3		x			
E Audio Signal Processing Applications	2	VO	3		x			
E Audio Signal Processors	1	VO	1.5	x				
E Audio Signal Processors Lab	2	LU	3	x				
E Music Perception	2	VO	3	x				
E Technical Audiology	2	VO	3		x			
Focus Area Neural Engineering - Basic								
C Cognitive Neuroscience	2	VO	3	x				
C Introduction to Brain-Computer Interfaces	1	VO	1.5	x				
C Methods of Functional Brain Research	2	VO	3		x			
C Non-Invasive Brain Computer Interfaces	2	VO	3		x	*		
C Non-Invasive Brain Computer Interfaces	2	KU	3		x			
C Rehabilitation Engineering	2	VO	3	x				
Focus Area Neural Engineering - Advanced								
C Neurocomputing, Seminar	2	SE	3.5		x			
C Neuroprosthetics	2	VO	3	x				
C Non-Invasive Brain Computer Interfaces 2	2	KU	3	x				
C Principles of Brain Computation	2	VO	3		x			
C Principles of Brain Computation	1	KU	2		x			

Elective Module Catalogue Software Technology

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_SWT (15 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 5.5 ECTS credit points must be selected. Connected rows must be selected in combination.
- **MA_ELECT_SWT (25 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_SWT (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Software Technology (SWT)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
Focus Area Software Engineering Principles								
C	Agile Software Development	3	VU	4		x	*	
C	Industrial Software Development and Quality Management	2	VO	3		x		
C	Industrial Software Development and Quality Management	1	UE	1.5		x		
C	Software Technology	3	VU	5		x	x	x
C	Software Technology Tools	2	SE	3		x		
Focus Area Software Technology and AI								
C	Advanced Topics in Artificial Intelligence	2	VO	3	x			
C	Advanced Topics in Artificial Intelligence	1	UE	2	x			
C	Basics in Artificial Intelligence and Logic	2	VU	3		x	*	
C	Configuration Systems	2	VU	3		x		
C	Explanations in Artificial Intelligence	2	VU	3		x		
C	Intelligent Systems	2	VO	3		x		
C	Intelligent Systems	1	KU	2		x		
C	Logic-Based Knowledge Representation	3	VU	4.5	x			
C	Recommender Systems	2	VU	3		x		
C	Software Engineering for Autonomous Robots	2	VU	3	x			
Focus Area Programming Languages								
C	Compiler Construction	2	VO	3		x	x	x
C	Compiler Construction	1	KU	2		x	x	x
C	Declarative Programming	2	VU	3		x		
C	Software Paradigms	3	VU	4.5		x		
C	Software Maintenance	3	VU	4.5		x		
Focus Area Specification and Modelling								
C	Formal Specification and Design of Software	3	VU	5	x			
C	Modelling Technical Systems	2	VO	3	x		*	
C	Modelling Technical Systems	1	KU	2	x			
C	Object-Oriented Analysis and Design	2	VU	3		x		

Elective Module Catalogue Software Technology (SWT)					Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor	
C Systems Engineering and Project Management	1	VO	1.5	x				
Focus Area Software Design and Architecture								
C Architecture of Database Systems	3	VU	5	x				
C Architecture of Machine Learning Systems	3	VU	5		x			
C Design Patterns	2	VO	3	x				
C Design Patterns	1	UE	2	x				
C Designing Interactive Systems	2	VU	3		x			
C Secure Software Development	3	VU	5	x				
Focus Area Validation & Verification								
C Verification and Model Checking	3	VU	5		x			
C Model-Based Testing	3	VU	5	x				
C Quality Assurance in Software Development	2	VU	2.5		x	*		
C Software Testing for Safety-Critical Systems	2	VO	3	x				
C Software Testing for Safety-Critical Systems	1	KU	2	x				
Focus Area Application Domains								
C Mobile Applications	3	VU	5		x			
C Secure Application Design	2	VO	3		x			
C Secure Application Design	1	KU	2		x			
C Software Engineering for Autonomous Robots	2	VU	3	x				

Elective Module Catalogue Visual Computing

The following modules can be completed by selecting courses from this elective module catalogue:

- **MA_COMP_VC (20 ECTS):** Compulsory subjects marked with (x) in the “Major” column must be considered when selecting courses for this module.
- **MA_ELECT_VC (20 ECTS):** There are no restrictions on the selection of courses for this module.
- **MI_VC (20 ECTS):** Compulsory subjects marked with (x) in the “Minor” column must be considered when selecting courses for this module.

Elective Module Catalogue Visual Computing (VC)				Semester allocation		Compulsory	
Course	SSt	Type	ECTS	WS	SS	Major	Minor
Focus Area Foundations of Visual Computing							
C Nonlinear Optimisation	3	VO	4.5	x			
C Nonlinear Optimisation	2	UE	2.5	x			
C Convex Optimisation	3	VU	5		x		
C Machine Learning 2	2	VO	3		x		
C Machine Learning 2	1	KU	2		x		
Focus Area Computer Graphics							
C 3D Computer Graphics and Realism	3	VU	5	x			
C GPU Programming	3	VU	5		x		
C Fundamentals of Geometry Processing	3	VU	4.5		x		
C Real-Time Graphics	2	VO	3	x		x	x
C Real-Time Graphics	1	KU	2	x		x	x
C Geometric 3D-Modelling in Computer Graphics	3	VU	5		x		
Focus Area Computer Vision							
C Robot Vision	2	VO	3		x	x	x
C Robot Vision	1	KU	2		x	x	x
C Camera Drones	3	VU	5	x			
C Image Processing and Pattern Recognition	2	VO	3	x		x	
C Image Processing and Pattern Recognition	1	KU	2	x		x	
C Image and Video Understanding	2	VO	3	x			
C Image and Video Understanding	1	KU	2	x			
C Medical Image Analysis	2	VO	3	x			
C Medical Image Analysis	1	KU	2	x			
Focus Area Visualisation and Virtual Reality							
C Virtual Reality	3	VU	5		x	x	
C Simulation and Animation	3	VU	5		x		
C Information Visualisation	3	VU	5	x			
C Computer-Aided Geometric Design	3	VU	5	x			
C Augmented Reality	3	VU	5	x			
C Seminar Visual Computing	3	SE	5		x		

Elective Module Catalogue Business, Law, and Management

The following module can be completed by selecting courses from this elective module catalogue:

- **MI_BLM (20 ECTS):** Compulsory subjects marked with (x) in the “Major” column and compulsory elective subjects (*) must be considered when selecting courses for this module. Compulsory elective subjects (*) totalling at least 2 ECTS credit points must be selected. Connected rows must be selected in combination.

Elective Module Catalogue Business, Law, and Management (BLM)					Semester allocation		Compulsory
Course	SSt	Type	ECTS	WS	SS	Minor	
Focus Area Business, Law, and Management Basics							
Business Sociology	2	VO	3	x			
Accounting for Computer Science Studies	3	VO	4	x		*	
Business Administration	3	VO	4.5		x	x	
Business Administration	2	UE	2		x	x	
Civil Law and Law of Business Enterprises	3	VO	4.5	x			
Focus Area Management Control, Accounting and Finance							
Management Control Systems	3	VO	4.5	x		*	
Industrial Law (Labor Law)	2	VO	3	x			
Staff Management	2	SE	2		x		
Business and Financial Statement Analysis	2	SE	2		x		
Financial Management	2	VO	3		x		
Focus Area Industrial Marketing, Purchasing and Supply Management							
Industrial Marketing	2	VO	3	x			
Purchasing and Supply Management	3	VO	4.5	x		*	
Rhetoric and Presentation	2	SE	2	x			
Marketing Management	3	SE	3		x		
Marketing Intelligence	1	SE	1		x		
Focus Area Management and Strategy							
General Management and Organisation	2	VO	3		x	*	
General Management and Organisation	2	UE	2		x		
General Management, Case Studies	3	SE	3		x		
Strategic Management	2	VO	3		x		
Strategy & Business Model Lab	3	LU	3	x			
Information Management	3	VU	4	x			
Focus Area Technology Entrepreneurship and Management							
Technology Management	2	VO	3		x	*	
Entrepreneurship	2	VO	3		x		
Entrepreneurship	1	UE	2		x		
Start-Up Garage	2	SE	2	x	x		
Business Model Management	2	SE	2		x		

Elective Module Catalogue Business, Law, and Management (BLM)					Semester allocation		Compulsory
Course	SSt	Type	ECTS	WS	SS	Minor	
Focus Area Industrial Management							
Production Strategies	2	SE	2	x		*	
Industrial Management Seminar	2	SE	2		x		
Operational Risk Management	1	VO	1.5		x		
Operational Risk Management	1	UE	1		x		
Quality Management	2	VO	3	x			
Industrial Energy Management	1	VO	1.5	x			
Industrial Energy Management	1	UE	1	x			
Safety and Sustainability	2	VO	3		x		
Focus Area Product Design and Innovation							
Innovation Management	2	VO	3	x		*	
Value Engineering	3	VU	3		x		
Creativity Techniques	2	VU	2		x		
Design Thinking and Rapid Prototyping	3	LU	3	x			
Selected Topics of Innovation Management	2	VU	2	x			
Change Management	1	VO	1.5	x			
Change Management	1	UE	1	x			
Focus Area Basics of Business Informatics and Digital Transformation							
Business Informatics	1	VO	1.5		x	*	
Business Informatics	2	UE	3		x		
Selected Topics of Business Informatics	2	VO	2	x			
Selected Topics of Business Informatics	1	UE	1	x			
Engineering Informatics Lab	3	LU	3	x	x		
Practice of Digital Transformation	1	VO	1		x		
Practice of Digital Transformation	1	UE	1		x		
Focus Area Business Operations and Processes							
Business Modelling and Simulation	2	VO	2	x			
Business Modelling and Simulation	2	UE	2	x			
Selected Topics of Business Informatics	2	SE	2		x		
Modelling and Optimisation in Production and Logistic Systems	2	VU	2		x	*	
Optimisation Methods for Operations Planning	3	VU	3		x		
Quantitative Methods for Business	2	VO	3	x			
Quantitative Methods for Business	2	UE	2	x			

Elective Module Catalogue Seminar/Project

To complete Elective Module SP, a seminar/project from the corresponding elective module catalogue must be chosen. The chosen seminar/project must belong to the subject area of either the major or the minor.

Elective Module Catalogue SP: Seminar/Project					Semester allocation	
Course	SSt	Type	ECTS	WS	SS	
Major/Minor Artificial Intelligence (AI)						
C Seminar/Project Artificial Intelligence	4	SP	10	x	x	
E Seminar/Project Machine Learning	4	SP	10	x	x	
Major/Minor Communications and Mobile Computing (CMC)						
E Seminar/Project Computational Electrodynamics	4	SP	10	x	x	
E Seminar/Project Technical Informatics	4	SP	10	x	x	
E Seminar/Project Telecommunications	4	SP	10	x	x	
Major/Minor Embedded and Automotive Systems (EAS)						
E Seminar/Project Technical Informatics	4	SP	10	x	x	
Major/Minor Information Security (ISEC)						
C Seminar/Project Information Security	4	SP	10	x	x	
Major/Minor Microelectronics and IC Design (ME)						
E Seminar/Project Electronics	4	SP	10	x	x	
Major/Minor Robotics (RO)						
C Seminar/Project Robotics	4	SP	10	x	x	
Major/Minor Sensing and Control Systems (SCS)						
E Seminar/Project Modelling, Simulation and Control	4	SP	10	x	x	
E Seminar/Project Microwave and Photonic Engineering	4	SP	10	x	x	
E Seminar/Project Measurement and Sensor Systems	4	SP	10	x	x	
Major/Minor Signal Processing and Human Communication (SPHC)						
E Seminar/Project Signal Processing	4	SP	10	x	x	
E Seminar/Project Speech Communication	4	SP	10	x	x	
E Seminar/Project Audio Communication	4	SP	10	x	x	
C Seminar/Project Neural Engineering	4	SP	10	x	x	
Major/Minor Software Technology (SWT)						
C Seminar/Project Software Technology	4	SP	10	x	x	
Major/Minor Visual Computing (VC)						
C Seminar/Project Visual Computing	4	SP	10	x	x	
Minor Business, Law, and Management (BLM)						
Seminar/Project Information Systems	6	SP	10	x	x	

Bridge Modules

The following tables define the bridge modules for admission to the Master's Degree Programme Information and Computer Engineering according to § 2 (1) b–e. If a student is required to complete a bridge module to qualify for admission to the degree programme, the respective bridge module must be completed instead of Elective Module X_ELECT.

Bridge Module BR_CS: Bridge – Computer Science					Semester allocation	
Course	SSt	Type	ECTS	WS	SS	
C Introduction to Data Structures and Algorithms	2	VO	3		x	
C Introduction to Data Structures and Algorithms	1	UE	1.5		x	
C Artificial Intelligence 1	3	VU	3	x		
C Object-Oriented Programming 1	1	VO	1.5		x	
C Object-Oriented Programming 1	3	KU	4		x	

Bridge Module BR_EEE: Bridge – Electrical Engineering					Semester allocation	
Course	SSt	Type	ECTS	WS	SS	
E Fundamentals of Discrete-Time Signals and Systems	2.5	VO	4		x	
E Circuit Design (ICE Bridge Module) ¹	3	VU	4.5	x		
E Digital Communications	2	VO	3		x	
E Digital Communications	1	UE	1.5		x	

¹ This course is offered only virtually.

§ 8 Free-choice subjects

- (1) The courses to be completed as part of the free-choice subjects in the Master's Degree Programme Information and Computer Engineering 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 list of recommended free-choice subjects.
- (2) If a specific free-choice course does not have an allocation of ECTS credit points, each semester hour (SSt) of this course is counted as one ECTS credit point. However, if such courses are lecture-type courses (VO), they are assigned 1.5 ECTS credit points for each semester course hour.
- (3) Additionally, the possibility exists, in accordance with § 11, to complete a professionally-oriented internship or short study period abroad as part of the free-choice subjects for up to 3 ECTS credit points.

§ 9 Master's thesis

- (1) The purpose of the master's thesis is to demonstrate a student's ability to work on scientific topics on their own, both with regard to content and methodology. The scope of the master's thesis must be determined in such a way that its completion can be reasonably and feasibly accomplished by the student within a period of six months.
- (2) The topic of the master's thesis must be taken from or meaningfully related to the chosen major or minor. However, the topic of the master's thesis cannot be related to the Elective Module Business, Law, and Management (BLM).
- (3) The master's thesis must be registered with the respective officer responsible for study matters via the Dean's Office before beginning work on it.

§ 10 Registration requirements for courses/examinations

To register for the final master's examination before a committee, the student must provide proof of positive assessment of all study achievements/examinations outlined in § 6 to § 8 as well as a positive assessment of the master's thesis.

§ 11 Stays abroad and internships

- (1) Recommended stays abroad

Students are recommended to complete a stay abroad during their degree programme. In this master's degree programme, the 2nd or 3rd semesters are particularly suitable for this purpose.

It is also possible to obtain recognition of work done during shorter stays abroad, for example while participating in summer or winter schools, as part of the free-choice subjects, by application to the officer responsible for study matters.

- (2) Internships

It is possible to include professionally-oriented internships/work experience in the free-choice subjects.

Each week of full employment corresponds to 1.5 ECTS credit points. Active participation in an academic event may also count as an internship. This internship must be approved by the officers responsible for study matters and considered a useful addition to the degree programme.

III. Examination Regulations and Conclusion of Studies

§ 12 Assessment of modules

The overall grade for a module is the average grade of all examinations completed as part of the module, weighted according to ECTS credit points. The grade is rounded up if the decimal place exceeds 0.5. Otherwise, the grade is rounded down. Examinations that are assessed only as “successfully completed/not completed” are not included in the calculation of the overall module assessment. Positive assessment of a module requires the positive assessment of all individual examinations to be completed within the module.

§ 13 Master’s examination

- (1) The master’s examination is an oral examination before a committee and consists of
 - the presentation of the master’s thesis (max. 25 minutes),
 - the defence of the master’s thesis (examination interview on the subject matter of the master’s thesis and other subject-related areas).
- (2) The total duration of the master’s examination before a committee is usually 60 minutes and must not exceed 75 minutes.
- (3) The examination committee for the master’s examination includes the supervisor of the master’s thesis and two other members who are nominated by the officer responsible for study matters, after hearing any recommendations from the candidate. The examination committee must be chaired by one of the members who is not the supervisor of the master’s thesis.
- (4) The master’s examination is graded by the committee based on the performance during the examination.

§ 14 Completion of studies

- (1) The master’s degree programme is completed once all academic achievements pursuant to § 3 have been assessed positively.
- (2) Successful completion of the degree programme is documented by issuing a certificate. The master’s degree certificate for the Master’s Degree Programme Information and Computer Engineering is composed of:
 - a. the chosen major and minor,
 - b. a list of all completed modules set out in § 3 (along with their ECTS credit points) and their assessments,
 - c. the title and assessment of the master’s thesis,
 - d. the assessment of the master’s examination,
 - e. the total in ECTS credit points completed in free-choice subjects, as defined in § 8, and
 - f. the overall assessment.

IV. Entry Into Force and Transitional Provisions

§ 15 Entry into force

This 2025 curriculum shall enter into force on 1 October 2025.

§ 16 Transitional provisions

This 2025 curriculum shall enter into force on 1 October 2025. Students of the Master's Degree Programme Information and Computer Engineering who are subject to the 2015 curriculum in its **2020 version** when this curriculum enters into force on **1 October 2025**, are entitled to complete their studies according to the provisions of the **2015 curriculum** in its 2020 version by **30 September 2028**. If the degree programme is not completed by **30 September 2028**, students become subject to the curriculum as amended. Students are entitled to voluntarily opt for the new curriculum at any time within the admission periods. To this end, an irrevocable written declaration must be sent to the officer responsible for study matters. The equivalence between those examinations completed within the framework of the curriculum version **2015** and those completed within the framework of the curriculum version **2025** is established in Appendix IV: Equivalence List.

Appendices to the curriculum of the Master's Degree Programme Information and Computer Engineering

Appendix I: Module Descriptions

Within the scope of the master's degree programme, students can choose a major and a minor from 11 different subject areas. Appendix I.1 to I.11 describe the subject areas as well as the corresponding modules students may choose as either a major (Compulsory Module MA_COMP and Elective Module MA_ELECT) or minor (Elective Module MI). Furthermore, appendices I.12 to I.14 describe Elective Module X_ELECT and Elective Module SP, as well as Bridge Module BR_CS and Bridge Module BR_EEE.

- Appendix I.1: Artificial Intelligence (AI)
- Appendix I.2: Communications and Mobile Computing (CMC)
- Appendix I.3: Embedded and Automotive Systems (EAS)
- Appendix I.4: Information Security (IS)
- Appendix I.5: Microelectronics and IC Design (ME)
- Appendix I.6: Robotics (RO)
- Appendix I.7: Sensing and Control Systems (SCS)
- Appendix I.8: Signal Processing and Human Communication (SPHC)
- Appendix I.9: Software Technology (ST)
- Appendix I.10: Visual Computing (VC)
- Appendix I.11: Business, Law, and Management (BLM)
- Appendix I.12: Cross-Catalogue Elective Courses
- Appendix I.13: Seminar Project
- Appendix I.14: Bridge – Computer Science, Bridge – Electrical Engineering

I.1 Artificial Intelligence (AI)

The specialisation Artificial Intelligence teaches the essential knowledge and skills required in the field of artificial intelligence and machine learning to prepare students for current and future challenges in the field of artificial intelligence. Students learn to independently develop and train AI systems, taking state-of-the-art methods into account. Specifically, the content of this specialisation is subdivided into the following focus areas:

- **AI Architectures and Foundations:** This focus area covers the fundamentals of artificial intelligence, logical reasoning, basic principles of information processing in the brain, nonlinear optimisation methods, nonlinear signal processing, and adaptive systems.
- **Data Science:** This focus area covers the fundamentals of automated knowledge processing, automated data analysis, and information retrieval.
- **Machine Learning:** This focus area covers methods of machine and deep learning.
- **AI Technologies:** This focus area covers advanced methods of artificial intelligence and knowledge retrieval, machine methods of image and video processing, and machine learning in embedded systems.
- **Language and Interaction:** This focus area covers automatic language recognition and processing, as well as explainable AI systems.
- **Intelligent Systems:** This focus area covers intelligent systems and recommendation services.

Module MA_COMP_AI	Major Artificial Intelligence – Compulsory Courses
ECTS credit points:	19.5
Contents:	This module provides the foundation for a comprehensive specialisation in artificial intelligence within the major. It covers fundamentals and applications from the subfields of machine learning, deep learning, and automated knowledge discovery and data processing.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • apply machine learning methods to simple problems. • create and train neural network models. • apply methods of automated knowledge acquisition and data analysis to practical problems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of multidimensional analysis and linear algebra, basic probability theory, programming skills
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_AI	Major Artificial Intelligence – Elective Courses
ECTS credit points:	20.5
Contents:	This module covers advanced concepts, methods, and applications in the field of artificial intelligence for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: non-linear optimisation, adaptive signal processing, probabilistic machine learning, reinforcement learning, embedded machine learning, natural language processing, and intelligent systems.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • identify, explain, and apply nonlinear optimisation methods. • explain and apply methods of adaptive signal processing and natural language processing. • identify, explain, and apply methods of probabilistic machine learning and reinforcement learning to simple problems. • design simple intelligent systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of multidimensional analysis and linear algebra, basic probability theory, programming skills
Frequency in which the module is provided:	Every academic year

Module MI_AI	Minor Artificial Intelligence
ECTS credit points:	20
Contents:	This module covers the central topics of artificial intelligence in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: nonlinear optimisation, adaptive signal processing, probabilistic machine learning, reinforcement learning, embedded machine learning, natural language processing, and intelligent systems.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • create and train neural network models. • apply methods of automated knowledge acquisition and data analysis to practical problems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of multidimensional analysis and linear algebra, basic probability theory, programming skills
Frequency in which the module is provided:	Every academic year

I.2 Communication and Mobile Computing (CMC)

Everyday objects and environments are increasingly equipped with wirelessly networked computer systems that use sensors to detect conditions and automatically adapt to them. This development is reflected in concepts such as the Internet of Things or cyber-physical systems. The specialisation Communications and Mobile Computing deals with advanced topics and applications of such systems, from radio-based communication technologies, self-organising sensor networks and their integration into the Internet, to the development of smart services and machine learning methods for resource-limited mobile systems. The content of this specialisation is subdivided into the following focus areas:

- **Mobile Computing:** This focus area covers fundamentals (computer systems and networks) as well as advanced topics in the field of mobile computer systems, such as automatic adaptation to changing environments (context-aware computing), energy-aware mobile computer systems (power-aware computing), innovative services for mobile systems (smart service development), and intelligent mobile systems (mobile computing).
- **Mobile Networks:** This focus area covers fundamentals (communication networks) as well as advanced topics in the field of wireless networking of mobile systems, such as sensor networks, integration of mobile systems into the internet (embedded internet), wireless positioning (low-power wireless localisation systems), and fault-tolerant distributed algorithms.
- **Digital Communications:** This focus area covers advanced topics in the field of digital communications technology (advanced digital communications, advanced telecommunications lab) such as information theory and coding theory and advanced information theory), modelling of wireless transmission channels, and satellite communications.
- **Signal Processing:** This focus area covers advanced topics in the field of signal processing (adaptive systems, estimation and detection theory for communications, and Bayesian inference for localisation, sensing, and communications).
- **Microwave Engineering:** This focus area covers advanced topics in the field of radio-frequency technology, such as guided wave propagation systems and components, radio-based systems (RF systems laboratory), and optical communication (optoelectronic communication engineering).
- **Wireless Systems:** This focus area covers fundamentals in the field of wireless radio systems, such as antennas and wave propagation, RF system design, radar systems, radio-based sensor systems (communication and sensing systems), and wireless power transmission.
- **Modelling, Simulation, and Optimisation:** This focus area covers advanced modelling (computational electromagnetics, electromagnetic fields, advanced electrodynamic laboratory, computational electromagnetics), simulation (multiphysical simulation) and optimisation of electromagnetic systems in general, and radio-based systems (smart antennas) in particular.

Module MA_COMP_CMC	Major Communications and Mobile Computing – Compulsory Courses
ECTS credit points:	13.5
Contents:	This module provides the foundation for a comprehensive specialisation in communications and mobile computing within the major. It covers fundamentals and applications from the focus areas of context-aware systems, mobile computing, communication networks, the Internet of Things, digital communication technology, information and coding theory, electromagnetic fields, as well as antennas and wave propagation.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the area of communications and mobile computing. • describe the properties, advantages, and disadvantages of methods in the area of communications and mobile computing and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of information and communication technology
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_CMC	Major Communications and Mobile Computing – Elective Courses
ECTS credit points:	26.5
Contents:	This module covers advanced concepts, methods, and applications in the field of communications and mobile computing for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: mobile computing, mobile networks, digital communications, signal processing, microwave engineering, wireless systems, modelling, and simulation and optimisation.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical specialised knowledge in the field of communications and mobile computing. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of information and communication technology
Frequency in which the module is provided:	Every academic year

Module MI_CMC	Minor Communications and Mobile Computing
ECTS credit points:	20
Contents:	This module covers the central topics of communications and mobile computing in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: mobile computing, mobile networks, digital communications, signal processing, microwave engineering, wireless systems, modelling, and simulation and optimisation.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the area of communications and mobile computing. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion.

	<ul style="list-style-type: none"> • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of information and communication technology
Frequency in which the module is provided:	Every academic year

I.3 Embedded and Automotive Systems (EAS)

The specialisation Embedded and Automotive Systems teaches the essential knowledge and skills for designing electronics, hardware, and software for embedded systems, as well as their application in various areas of system development (e.g., automation, communication, control, signal processing, etc.). The module covers embedded systems in general, but allows for additional focus on automotive systems. Students learn to independently design, implement, evaluate, and analyse reliable hardware and software using state-of-the-art methods. The fundamentals are primarily taught in lectures, supplemented with practical laboratory exercises. The content of this specialisation is subdivided into the following focus areas:

- **Electronics:** This focus area covers the development of electronic systems, electromagnetic compatibility, electronic systems as well as sensors and actuators for vehicles.
- **Embedded Hardware:** This focus area covers an introduction to embedded systems, design of processor architectures, implementation of microcontrollers, hardware-software codesign, design of real-time systems.
- **Embedded Software:** This focus area covers the application of microcontrollers, design of real-time operating systems, software development for vehicles, design of distributed systems, algorithms for digital signal processing.
- **Measurement and Engineering:** This focus area covers an introduction to automotive technology, electronic sensors and measuring systems for vehicles, fundamentals of electric drives, innovative drives and vehicle concepts.
- **Automation, Control, and Communication:** This focus area covers process automation and control engineering, process instrumentation and measurement technology, communication systems for real-time applications.
- **Software Development and Services:** This focus area covers software development and quality management, design principles in software development, concepts of IT-based services, fault-tolerant systems.

Module MA_COMP_EAS	Major Embedded and Automotive Systems – Compulsory Courses
ECTS credit points:	19.5
Contents:	This module provides the foundation for a comprehensive specialisation in embedded and automotive systems within the major. It covers fundamentals and applications in the areas of embedded systems, electronics, hardware, software, and networking.
Learning outcomes:	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the areas of hardware, software, and electronics of networked embedded systems. • independently and purposefully design, implement, and evaluate reliable embedded systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion.

	<ul style="list-style-type: none"> • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer organisation and distributed systems as well as basic programming skills
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_EAS	Major Embedded and Automotive Systems – Elective Courses
ECTS credit points:	20.5
Contents:	This module covers advanced concepts, methods, and applications in the field of embedded and automotive systems for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: electronics, embedded hardware, embedded software, measurement and engineering, automation, control, and communication, and software development and services.
Learning outcomes:	<p>After completing this module, depending on the elective subjects chosen, students are able to</p> <ul style="list-style-type: none"> • explain and apply advanced knowledge in the areas of electronics, embedded hardware, embedded software, measurement and engineering, automation, control, and communication, and software development and services. • independently and purposefully design, implement, and evaluate reliable embedded systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer organisation and distributed systems as well as basic programming skills
Frequency in which the module is provided:	Every academic year

Module MI_EAS	Minor Embedded and Automotive Systems
ECTS credit points:	20
Contents:	This module covers the central topics of embedded and automotive systems in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: design of real-time systems, distributed systems, communication systems for real-time applications, software development for vehicles, and electronic systems for vehicles.
Learning outcomes:	<p>After completing this module, depending on the elective subjects chosen, students are able to</p> <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the areas of hardware, software, and electronics of networked embedded systems. • independently and purposefully design, implement, and evaluate reliable embedded systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer organisation and distributed systems as well as basic programming skills

Frequency in which the module is provided:	Every academic year
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I.4 Information Security (ISEC)

The specialisation Information Security teaches the essential knowledge and skills needed to develop applications and systems protected against various types of attacks, as well as to analyse and evaluate their security. The courses in this specialisation cover the methodological spectrum from basic research to current application and development areas. The content of this specialisation is subdivided into the following focus areas:

- **System Security:** This focus area covers secure implementations and system architectures form the basis for information security, development of secure software and hardware, attacks and countermeasures, efficient implementation of security mechanisms and cryptographic algorithms, implementation security and side channels, systematic security analysis, and advanced system architectures.
- **Cryptology and Privacy:** This focus area covers cryptographic algorithms are the mathematical foundation for secure communication and data protection, design and cryptanalysis of cryptographic algorithms, the fundamentals of symmetric and asymmetric cryptography, privacy protection technologies, mathematical foundations, and coding theory.
- **Formal Methods:** To ensure the security of an implementation, it must be guaranteed that the implementation conforms to the formal specification. This focus area covers verification and testing of implementations based on models and formal specifications of software, computability, and the traceability and trustworthiness of artificial intelligence.
- **Secure Applications:** This focus area covers information security concepts are put into practice, including the development of secure applications and architectures, risk analysis, security of mobile applications and networks, and the life cycle of secure products.

Module MA_COMP_ISEC	Major Information Security – Compulsory Courses
ECTS credit points:	20
Contents:	This module provides the foundation for a comprehensive specialisation in information security within the major. It covers the fundamentals and applications of cryptography, secure software development, theoretical and practical foundations in formal software modelling and verification, and the development of secure and privacy-oriented application architectures and protocols based on cryptographic algorithms.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply fundamental aspects of cryptography, secure software implementation, modelling and verification, and secure system design. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of information security
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_ISEC	Major Information Security – Elective Courses
ECTS credit points:	20
Contents:	This module covers advanced concepts, methods, and applications in the field of information security for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: system security, cryptography and privacy, formal methods and secure applications.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge of the structure and security of digital systems. • model complex, security-critical systems and analyse them using state-of-the-art testing and verification methods. • relate the properties, advantages, and disadvantages of information security methods and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of system security, cryptography and formal methods from the Compulsory Module Information Security
Frequency in which the module is provided:	Every academic year

Module MI_ISEC	Minor Information Security – Compulsory Courses
ECTS credit points:	20
Contents:	This module covers the central topics of information security in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: system security, cryptography and privacy, formal methods and secure applications.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain fundamental aspects of cryptography and secure software implementation and apply them in practice. • model security-critical systems and analyse them using state-of-the-art testing and verification methods. • relate the properties, advantages, and disadvantages of information security methods and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of information security
Frequency in which the module is provided:	Every academic year

I.5 Microelectronics and IC Design

The specialisation Microelectronics and IC Design teaches the essential knowledge and skills required in the field of microelectronics and integrated circuit technology to prepare students for current and future challenges in the design and verification of analogue and digital integrated circuits.

Students deepen their knowledge of semiconductor physics and IC design technology with the goal of gaining a deep understanding of integrated circuit development. They learn to independently design and implement electronic systems and devices – from the initial concept and product specification to full commissioning. Furthermore, it covers modern design methods, simulation techniques, and consideration of interactions with other systems and the environment, particularly with regard to electromagnetic compatibility (EMC). Specifically, the content of this specialisation is subdivided into the following focus areas:

- **Microelectronics Fundamentals:** This focus area covers the fundamental principles of microelectronics, including IC design flow, semiconductor physics, transistor and diode models, and basic circuit techniques and applications. Microchip manufacturing processes are also covered.
- **Analog Design:** This focus area covers the design, simulation, and optimisation of analogue circuits used in a wide variety of electronic applications, in particular the precise simulation and analysis of components such as amplifiers, filters, and voltage regulators, among others, to maximise their performance and efficiency.
- **Digital Design:** This focus area covers the fundamental methods of digital circuit design crucial for the development of modern electronic systems. It includes design techniques for combinational logic, such as logic gates and switching circuits, as well as for sequential logic based on memory and control structures such as flip-flops, registers, and state machines.
- **Analog Layout, Test and Verification:** This focus area covers the creation of layouts for analogue circuits, taking parasitic effects and matching into account, as well as techniques for the testability and verification of integrated circuits.
- **Advanced Analog Design:** This focus area covers advanced topics in the field of analogue design to convey advanced techniques and concepts.
- **Robust Design:** This focus area covers the electromagnetic compatibility of circuits, as well as their protection against electrostatic discharge and radiation influences, and the reliability of integrated circuits.
- **RF Design:** This focus area covers the design, simulation and analysis of radio frequency circuits, which play a central role in communications technology and numerous other applications.

Module MA_COMP_ME	Major Microelectronics and IC Design – Compulsory Courses
ECTS credit points:	19
Contents:	This module provides the foundation for a comprehensive specialisation in microelectronics and IC design within the major. It covers the fundamental concepts and design processes of analogue and digital integrated circuits.
Learning outcomes:	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> • describe the basic design process of integrated circuits. • design, simulate, and dimension analogue circuits. • describe digital circuits using hardware description languages and synthesise them with appropriate software.

	<ul style="list-style-type: none"> relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of electronics: components (resistors, capacitors, inductors, diodes, transistors), basic electronic circuits (operational amplifiers, ADCs, DACs, etc.), small-signal equivalent circuits; basic knowledge of circuit simulation
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_ME	Major Microelectronics and IC Design – Elective Courses
ECTS credit points:	21
Contents:	This module covers advanced concepts, methods, and applications in the field of microelectronics and IC design for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: analogue design, digital design, analogue layout test and verification, robust design, RF design, and semiconductor physics.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> design, simulate, and dimension analogue circuits. layout analogue circuits. describe digital circuits using hardware description languages and synthesise them with appropriate software. test and verify integrated circuits. develop integrated circuits with a particular focus on electromagnetic compatibility and radiation resistance. relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. apply methods from the subject areas in practice.
Prerequisites for participation:	Knowledge of microelectronics from courses of module MA_COMP_ME
Frequency in which the module is provided:	Every academic year

Module MI_ME	Minor Microelectronics and IC Design
ECTS credit points:	20
Contents:	This module covers the central topics of microelectronics and IC design in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: analogue design, digital design, analogue layout test and verification, robust design, RF design, and semiconductor physics.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> describe the basic design process of integrated circuits. design, simulate, and dimension analogue circuits. layout analogue circuits. describe digital circuits using hardware description languages and synthesise them with appropriate software. test and verify integrated circuits. develop integrated circuits with a particular focus on electromagnetic compatibility and radiation resistance. relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. apply methods from the subject areas in practice.

Prerequisites for participation:	Fundamental knowledge of electronics: components (resistors, capacitors, inductors, diodes, transistors), basic electronic circuits (operational amplifiers, ADCs, DACs, etc.), small-signal equivalent circuits; basic knowledge of circuit simulation
Frequency in which the module is provided:	Every academic year

I.6 Robotics (RO)

The specialisation Robotics teaches in-depth knowledge of the field of robotics, focussing on the core topics of perception, state estimation and control, deciding, acting, interacting, and navigation. The content of this specialisation is subdivided into the following focus areas:

- **Foundations of Robotics:** This focus area covers the fundamentals of kinematics, filtering, autonomous intelligent systems, software, and sensor technology relevant to robotics.
- **Perception:** This focus area covers advanced topics in the fields of 3D computer vision, deep learning, and multimodal perception.
- **State Estimation and Control:** This focus area covers advanced topics in the field of control engineering, such as controller and observer design, state estimation and filtering, as well as computer-aided modelling and modelling of mechatronic systems.
- **Deciding, Acting, Interacting, Navigation:** This focus area covers advanced topics relevant to intelligent systems in the fields of perception and decision-making in robotic systems, knowledge representation, and machine learning.
- **Engineering:** This focus area covers advanced topics in the field of robotic system design and relevant software development.

Module MA_COMP_RO	Major Robotics – Compulsory Courses
ECTS credit points:	15
Contents:	This module provides the foundation for a comprehensive specialisation in robotics within the major. It covers the mathematical description of robot systems and methods for solving fundamental problems such as localisation, path planning, and mapping, as well as 3D computer vision methods for environmental perception.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge of intelligent and mobile robot systems and 3D computer vision methods. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • describe mobile robot systems and solve fundamental tasks. • develop modules for robot systems that enable "vision" and "reasoning." • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of software development
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_RO	Major Robotics – Elective Courses
ECTS credit points:	25
Contents:	This module covers advanced concepts, methods, and applications in the field of robotics for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: foundations of robotics, perception, state estimation and control, deciding, acting, interacting, navigation und engineering.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge of intelligent and mobile robot systems and 3D computer vision methods. • design software modules for robot systems and solve robotics tasks. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of software development
Frequency in which the module is provided:	Every academic year

Module MI_RO	Minor Robotics
ECTS credit points:	20
Contents:	This module covers the central topics of robotics in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: foundations of robotics, perception, state estimation and control, deciding, acting, interacting, navigation und engineering.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge of intelligent and mobile robot systems and 3D computer vision methods. • design software modules for robot systems and solve robotics tasks. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of software development
Frequency in which the module is provided:	Every academic year

I.7 Sensing and Control Systems (SCS)

The specialisation Sensing and Control Systems teaches advanced knowledge in the areas of sensor technology, measurement technology, signal processing, control engineering, modelling, and optimisation. The content of this specialisation is subdivided into the following focus areas:

- **Control Systems:** This focus area covers fundamentals in the field of control engineering, such as controller and observer design, as well as state estimation and filtering.
- **Advanced Control Concepts:** This focus area covers advanced topics in the field of control engineering, such as computer-aided controller design and the control of distributed parametric and multivariable systems.
- **Optimisation and Optimal Control:** This focus area covers the fundamentals of optimisation as well as advanced topics in the field of optimal control design.
- **Nonlinear and Adaptive Systems:** This focus area covers fundamentals as well as advanced topics in the field of nonlinear and adaptive systems such as nonlinear signal processing and nonlinear control engineering.
- **Modelling and Electric Machines:** This focus area covers advanced topics in the field of modelling and electrical machines such as computer-aided modelling, modelling of mechatronic systems, similarity theory and the control of electrical machines.
- **Condition Monitoring:** This focus area covers fundamentals as well as advanced topics in the field of condition monitoring such as signal analysis, process instrumentation, measurement uncertainties and multi-sensor data fusion.
- **Sensors:** This focus area covers advanced topics in the field of sensor technology such as photonics and physical effects for sensors, electrodynamics, environmental sensing and quantum sensing.
- **Measurement Systems:** This focus area covers advanced topics in the field of measurement systems such as measurement electronics, energy harvesting, automotive measurement technology and high-frequency measurement technology.

Module MA_COMP_SCS	Major Sensing and Control Systems – Compulsory Courses
ECTS credit points:	13.5
Contents:	This module provides the foundation for a comprehensive specialisation in sensing and control systems within the major. It covers fundamentals and applications in the field of sensing and control systems, including signal analysis, the design of discrete-time control loops, and state estimation and filtering.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the areas of signal analysis, the design of discrete-time control loops, state estimation, and filtering. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of measurement and control technology
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_SCS	Major Sensing and Control Systems – Elective Courses
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ECTS credit points:	26.5
Contents:	This module covers advanced concepts, methods, and applications in the field of sensing and control systems for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: control systems, advanced control concepts, optimisation and optimal control, nonlinear and adaptive systems, modelling and electric machines, condition monitoring, sensors and measurement systems.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge in the field of sensing and control systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of measurement and control technology
Frequency in which the module is provided:	Every academic year

Module MI_SCS	Minor Sensing and Control Systems
ECTS credit points:	20
Contents:	This module covers the central topics of sensing and control systems in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: control systems, advanced control concepts, optimisation and optimal control, nonlinear and adaptive systems, modelling and electric machines, condition monitoring, sensors and measurement systems.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the field of sensing and control systems. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of measurement and control technology
Frequency in which the module is provided:	Every academic year

I.8 Signal Processing and Human Communication (SPHC)

We can hear, see, speak, feel, think and regulate all processes of life with signals and have trained our communication and information devices, cars, machines, etc. to make use of them. The specialisation Signal Processing and Human Communication allows to combine competencies in signal processing and machine learning methods with three modalities of human communication: speaking, hearing, and thinking. This is essential for making technical solutions tangible and manageable for people.

The content of this specialisation is subdivided into the following focus areas: signal processing, speech communication, audio communication and neural engineering. For each focus area, there are “Basic” and “Advanced” courses. “Basic” courses do not necessarily have to be completed before taking “Advanced” courses; the naming convention is simply intended to provide guidance on how to select the most important topics for optimal alignment with individual interests. The content of this specialisation is subdivided into the following focus areas:

- **Signal Processing:** This focus area covers signal processing algorithms that will drive future highly integrated information technology systems to peak performance. It also introduces essential foundations for explainable machine learning systems (learning for linear systems, processing with nonlinear systems, information-theoretic approaches to machine learning).
- **Speech Communication:** This focus area covers spoken and written human-human and human-machine communication, ranging from transmission and storage to automatic recognition and synthesis of spoken language, text-based speech processing, and systems for dialogue and conversation. Methods of signal processing and machine learning are used and linked in an interdisciplinary manner with linguistics.
- **Audio Communication:** This focus area covers digital audio technology and signal processing to create engaging listening experiences for people. It also scientifically examines hearing as a sensory perception, including with regard to music perception and hearing aids.
- **Neural Engineering:** This focus area covers diverse aspects of neurotechnology, from neuroprostheses to brain-computer interfaces. It thus focuses on the last step from sensory perception, cognitive processing to motor control. Technical methods are thus combined with an understanding of human communication and brain research.

Module MA_COMP_SPHC	Major Signal Processing and Human Communication – Compulsory Courses
ECTS credit points:	15
Contents:	This module provides the foundation for a comprehensive specialisation in signal processing and human communication within the major. It introduces key fundamentals of signal processing – adaptive (i.e., learning) systems and signal analysis (i.e., information processing). It also provides an introduction to one of the three communication modalities: speaking, listening, or thinking.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the areas of signal processing and one of the three communication modalities. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion.

	<ul style="list-style-type: none"> • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of discrete-time signal and systems theory, probability theory, stochastic processes and linear algebra
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_SPHC	Major Signal Processing and Human Communication – Elective Courses
ECTS credit points:	25
Contents:	This module covers advanced concepts, methods, and applications in the field of signal processing and human communication for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: signal processing, speech communication, audio communication, and neural engineering – each structured into “Basic” and “Advanced” courses.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge from the areas of signal processing, speech communication, audio communication, and neural engineering. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of discrete-time signal and systems theory, probability theory, stochastic processes and linear algebra Competencies from the corresponding compulsory module
Frequency in which the module is provided:	Every academic year

Module MI_SPHC	Minor Signal Processing and Human Communication
ECTS credit points:	20
Contents:	This module covers the central topics of signal processing and human communication in a concise manner. Compulsory elective subjects within the module teach important fundamentals of signal processing, adaptive (i.e., learning) systems, and signal analysis (i.e., information processing). The elective subjects allow for in-depth specialisation in the following focus areas: signal processing, speech communication, audio communication and neural engineering.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge from the areas of signal processing, speech communication, audio communication, and neural engineering. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of discrete-time signal and systems theory, probability theory, stochastic processes and linear algebra
Frequency in which the module is provided:	Every academic year

I.9: Software Technology (SWT)

The specialisation Software Technology teaches in-depth knowledge of the fundamentals, methods, and techniques of software development. The content of this specialisation is subdivided into the following focus areas:

- **Software Engineering Principles:** Topics include agile development methods, industrial methods, programme analysis, and development tools.
- **Software Technology and Artificial Intelligence:** This focus area covers the systematic development of symbolic artificial intelligence. This includes the necessary foundations and in-depth study of knowledge representation, the development of recommendation systems, and robot programming.
- **Programming Languages:** This focus area covers the fundamentals of programming languages and compiler development. The software paradigms covered include functional, imperative, and logical programming.
- **Specification and Modelling:** This focus area covers abstract description of software using specifications and models.
- **Software Design and Architecture:** This focus area covers the design and architecture of software systems.
- **Validation & Verification:** This focus area covers the security and quality control of software. One focus is the automation of these processes.
- **Application Domains:** This focus area covers the specific requirements of certain application domains, such as mobile applications, safety-critical applications or robotics.

Module MA_COMP_SWT	Major Software Technology – Compulsory Courses
ECTS credit points:	15
Contents:	This module provides the foundation for a comprehensive specialisation in software technology within the major. It covers the fundamentals and applications of software technology with a focus on programming languages and their principles. This includes analysis methods for debugging and test case generation, as well as compiler construction. It also covers key topics such as development methods, logic-based artificial intelligence, modelling, and quality assurance.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain the fundamentals of programme analysis tools. • apply the presented tools in programming. • design their own programming languages and compilers. • explain and apply theoretical and practical knowledge from one or more of the areas of development methods, logic-based artificial intelligence, modelling, and quality assurance. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of programming and data structures as well as discrete mathematics
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_SWT	Major Software Technology – Elective Courses
ECTS credit points:	15
Contents:	This module covers advanced concepts, methods, and applications in the field of software technology for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: software technology and AI, programming languages, specification and modelling, software design and architecture, validation & verification, and application domains.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge in the field of software technology. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of programming and data structures as well as discrete mathematics

Module MI_SWT	Minor Software Technology
ECTS credit points:	20
Contents:	This module covers the central topics of software technology in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: software technology and AI, programming languages, specification and modelling, software design and architecture, validation & verification, and application domains.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the field of software technology. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of programming and data structures as well as discrete mathematics

I.10 Visual Computing (VC)

The specialisation Visual Computing teaches in-depth knowledge of the field of visual Computing, focussing on the core topics of computer graphics, computer vision, and visualisation. The content of this specialisation is subdivided into the following focus areas:

- **Foundations of Visual Computing:** This focus area covers fundamentals in machine learning, 3D geometry data processing and optimisation relevant to the field of visual computing.
- **Computer Graphics:** This focus area covers advanced topics in the field of computer graphics, including real-time graphics, GPU programming and the modelling of 3D geometries.
- **Computer Vision:** This focus area covers advanced topics in the field of computer vision, including pattern recognition, image understanding and 3D image processing.
- **Visualisation and Virtual Reality:** This focus area covers advanced topics in the fields of visualisation and virtual reality, including topics such as information visualisation, virtual reality as well as CAD design and animation.
- **Augmented Reality, Robotics, Medical:** This focus area covers advanced topics in the broader field of visual computing, including topics such as augmented reality, image processing for robotic systems and medical image processing.

Module MA_COMP_VC	Major Visual Computing – Compulsory Courses
ECTS credit points:	20
Contents:	This module provides the foundation for a comprehensive specialisation in visual computing within the major. It covers fundamentals and applications from the focus areas of image processing, pattern recognition, 3D computer vision, real-time graphics and virtual reality.
Learning outcomes:	After completing this module, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge in the areas of image processing, pattern recognition, 3D computer vision, real-time graphics and virtual reality. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer graphics and computer vision
Frequency in which the module is provided:	Every academic year

Module MA_ELECT_VC	Major Visual Computing – Elective Courses
ECTS credit points:	20
Contents:	This module covers advanced concepts, methods, and applications in the field of visual computing for in-depth specialisation within the major. The elective subjects for this module cover the following focus areas: foundations of visual computing, computer vision, computer graphics, visualisation and virtual reality, augmented reality, robotics and medical.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply advanced theoretical and practical knowledge from various areas of computer vision, computer graphics, visualisation and virtual/augmented reality. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer graphics and computer vision
Frequency in which the module is provided:	Every academic year

Module MI_VC	Minor Visual Computing
ECTS credit points:	20
Contents:	This module covers the central topics of visual computing in a concise manner. Compulsory elective subjects within the module focus on the fundamentals, while elective subjects allow for in-depth specialisation in the following focus areas: foundations of visual computing, computer vision, computer graphics, visualisation and virtual reality, augmented reality, robotics and medical.
Learning outcomes:	After completing this module, depending on the elective subjects chosen, students are able to <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge from various areas of computer vision, computer graphics, visualisation and virtual/augmented reality. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	Fundamental knowledge of computer graphics and computer vision
Frequency in which the module is provided:	Every academic year

I.11 Business, Law, and Management (BLM)

The specialisation Business, Law, and Management can only be chosen as a minor and provides basic knowledge in the fields of economics, law, and management. The skills acquired in the module provide students with a solid foundation for assuming management functions or for founding their own business. The content of this specialisation is subdivided into the following focus areas:

- **Business, Law, and Management Basics:** This focus area covers a comprehensive introduction to business administration with a particular focus on practice-relevant approaches that integrate technological and socioeconomic aspects. Students are introduced to key business topics, such as corporate organisation, human resources management, purchasing and procurement, production, marketing and sales, financing and investment, business analysis, and controlling. The focus area also provides an introduction to civil law and corporate law, as well as the fundamentals of business sociology.
Students are introduced to the mechanisms of social interaction within companies, with particular emphasis on the “soft facts” that play a central role in software projects. Furthermore, the most important “hard facts” of accounting are covered, as they are essential for sound business management in information technology.
- **Management Control, Accounting and Finance:** This focus area covers fundamentals and advanced topics in the fields of performance-oriented and financial management of companies, employee management, and labour law. Students learn key concepts of cost management, financial management, and the analysis of company key performance indicators for operational and strategic decision-making.
- **Industrial Marketing, Purchasing and Supply Management:** This focus area covers procurement and sales market-oriented strategies, marketing, and procurement processes, and integrates communication and presentation skills in an industrial, technology-oriented business environment. Students develop a holistic understanding of the complexity of industrial markets, thus recognising the high relevance of data-driven, multidimensional decision-making in companies.
- **Management and Strategy:** This focus area covers fundamentals and advanced topics in the fields of general management and strategic corporate leadership. It combines theoretical approaches with practical applications to prepare students for leadership positions, particularly in technology-oriented companies.
- **Technology Entrepreneurship and Management:** This focus area covers fundamentals and advanced topics in the fields of technology management and company formation. It combines theoretical approaches with practical applications.
- **Industrial Management:** This focus area covers the fundamentals of management in industrial companies. Students explore basic topics of industrial management such as production strategies, risk, quality, and energy management, as well as sustainable value creation with regard to social (e.g., occupational safety), ecological (environmental), and economic aspects.
- **Product Design and Innovation:** This focus area covers the fundamentals of industrial innovation and product development. Students learn how companies practice innovation management, how to develop targeted new ideas and transform them into prototypes, and thus increase the value of their product or service on the market.

- **Basics of Business Informatics and Digital Transformation:** This focus area covers fundamentals and advanced topics in the field of information use and communication technologies in business. Particular emphasis is placed on the practical implementation of theoretical concepts from the fields of business informatics and digital transformation.
- **Business Operations and Processes:** This focus area covers specific tasks in a business context. In addition to systematic process analysis, students learn how to build simulation models and use simulation and optimisation tools based on application scenarios relevant to business, production, and logistics.

Module MI_BLM	Minor Business, Law, and Management (BLM)
ECTS credit points:	20
Contents:	<p>This module offers a concise introduction to key topics in the fields of economics, law, and management. In addition to the fundamentals, students can choose from courses in the following focus areas for specialisation:</p> <ul style="list-style-type: none"> • Management Control, Accounting and Finance • Industrial Marketing, Purchasing and Supply Management • Management and Strategy • Technology Entrepreneurship and Management • Industrial Management • Product Design and Innovation • Basics of Business Informatics and Digital Transformation • Business Operations and Processes
Learning outcomes:	<p>After completing this module, depending on the elective subjects chosen, students are able to</p> <ul style="list-style-type: none"> • explain and apply fundamental theoretical and practical knowledge from the fields of economics, law, and management. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice. • successfully assume management functions in companies. • analyse the market value of a product or service and use relevant methods to specifically increase value through innovation. • devise a production strategy, taking into account existing risks and their impact on operational sustainability (economic, ecological, social). • understand approaches to digital transformation and assess their operational and financial impacts. • understand production and logistics principles and analyse business processes. • apply quantitative evaluation and optimisation methods to real-world scenarios.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

I.12 Cross-Catalogue Elective Courses

Module X_ELECT	Cross-Catalogue Elective Courses
ECTS credit points:	14
Contents:	<p>This elective module is intended to supplement the content of the chosen specialisation within the major and minor. Elective subjects can be chosen from all specialisations</p> <ul style="list-style-type: none"> • Artificial Intelligence (AI) • Communications and Mobile Computing (CMC) • Embedded and Automotive Systems (EAS) • Information Security (ISEC) • Microelectronics and IC Design (ME) • Robotics (RO) • Sensing and Control Systems (SCS) • Signal Processing and Human Communication (SPHC) • Software Technology (SWT) • Visual Computing (VC) • Business, Law, and Management (BLM) <p>The module thus offers the opportunity, for example, to advance the content of the major or the minor, or to acquire complementary skills.</p>
Learning outcomes:	<p>After completing this module, depending on the elective subjects chosen, students are able to</p> <ul style="list-style-type: none"> • explain and apply theoretical and practical knowledge from one or more subject areas selected during the course of study. • relate the properties, advantages, and disadvantages of methods from these areas and justify them in an expert discussion. • apply methods from the subject areas in practice.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

I.13 Seminar Project

Module SP	Seminar/Project
ECTS credit points:	10
Contents:	<p>As part of this elective module, students must complete a seminar/project in the field of the chosen major or minor. For some specialisations, seminar projects with different focuses within the specialisation of the major or minor are also available.</p> <p>Skills taught in the seminar/project include:</p> <ul style="list-style-type: none"> • practical and/or theoretical implementation of a specific topic in the chosen field of the major or minor. • independent review of the relevant literature and derivation of a problem. • analysis and processing of the problem and drawing the necessary conclusions. • writing of an academic paper and subsequent oral presentation.
Learning outcomes:	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> • conduct academic research. • formulate and address practical and/or theoretical problems. • write academic and scientific texts. • communicate information, ideas, problems, and their solutions clearly and concisely. • use communication and presentation techniques appropriately.
Prerequisites for participation:	Course content from MA_COMP, MA_ELECT or MIT of the discipline chosen for the seminar/project
Frequency in which the module is provided:	Every academic year

I.14 Bridge – Computer Science, Bridge – Electrical Engineering

Module BR_CS	Bridge – Computer Science
ECTS credit points:	13
Contents:	This module teaches key principles in the field of computer science. These include the fundamentals of object-oriented programming in C++, elementary data structures, asymptotic runtime analysis of programs (O notation), and the fundamentals of applied artificial intelligence.
Learning outcomes:	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> • work in an object-oriented manner using the C++ programming language. • debug and test programmes effectively. • select and use suitable data structures for applications. • select and apply suitable algorithms for sorting or search problems. • determine the asymptotic runtime of algorithms using O notation. • apply methods from the field of artificial intelligence.
Prerequisites for participation:	Fundamental knowledge of programming
Frequency in which the module is provided:	Every academic year

Module BR_EEE	Bridge – Electrical Engineering
ECTS credit points:	13
Contents:	This module teaches key principles in the field of electrical engineering. These include the fundamentals of electrical and electronic components, circuit design, digital communications, and digital signal processing.
Learning outcomes:	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> • know and apply key electrical and electronic components and basic circuits. • structure tasks in electronic circuit design as well as design and dimension circuits. • explain mathematical concepts for signals and systems. • apply signal representations in vector spaces. • apply signal sampling and reconstruction. • calculate the Fourier transform in its various forms (Fourier series, DFT, DTFT, FFT). • design digital transmission systems for AWGN channels and characterise their performance.
Prerequisites for participation:	none
Frequency in which the module is provided:	Every academic year

Appendix II: Recommended Free-Choice Subjects

Students can choose free-choice subjects as desired in accordance with § 8 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 recommended:

- 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 Uni Graz,
- the transfer initiative for management and entrepreneurship fundamentals, awareness, training and employability ("TIMEGATE"), and
- Centre for Social Competence of Uni Graz.

Furthermore, TU Graz offers a certificate programme for key competencies. Certificates can be earned in the following areas:

- Entrepreneurship – Entrepreneurial acting and thinking
- STS – Science, Technology and Society
- Social Skills & Diversity
- Languages

Appendix III: Equivalence List

- (1) Equivalency of courses when switching from the expiring Master's Degree Programme Information and Computer Engineering curriculum 2015 in the version 2020 to the new curriculum 2025

The courses of the current curriculum are listed on the left-hand side of the table. The corresponding equivalent courses in the expiring curriculum version of the Master's Degree Programme Information and Computer Engineering are listed on the right-hand side of the table. Any courses of the expiring curriculum that have no equivalent course according to this list may be taken as free-choice courses.

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

New curriculum Information and Computer Engineering 2025					Expiring curriculum Information and Computer Engineering 2015 in the version 2020				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Courses at the Faculty of Computer Science and Biomedical Engineering									
Logic-Based Knowledge Representation	VU	4.5	3		Logic-Based Knowledge Representation	VU	4	3	
Probabilistic Decision Making	VU	5	3		Reinforcement Learning	VO	3	2	
					and Reinforcement Learning	UE	2	1	
Mathematical Foundations of Cryptography	SE	3.5	2		Seminar Cryptology and Privacy	SE	3.5	2	
Virtual Reality and 2 ECTS can be recognised for X_ELECT	VU	5	3		Virtual Reality	VU	7	4	
Verification and Model Checking	VU	5	3		Verification and Testing	VO	3	2	
					and Verification and Testing	UE	2	1	

New curriculum Information and Computer Engineering 2025					Expiring curriculum Information and Computer Engineering 2015 in the version 2020				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Hardware Design for Security	VU	5	3		Digital System Design	VO	3	2	
					and Digital System Design	KU	2	1	
Cryptanalysis	VU	5	3		Cryptanalysis	VO	3	2	
					and Cryptanalysis	KU	3	1	
Secure Software Development	VU	5	3		Secure Software Development	VO	3	2	
					and Secure Software Development	KU	2	1	
Artificial Intelligence 2	VU	3	2		Basics in Artificial Intelligence and Logic	VU	3	2	
Courses at the Faculty of Electrical and Information Engineering									
Adaptive Systems	UE	1.5	1		Adaptive Systems	UE	2	1	
Nonlinear Signal Processing	UE	1.5	1		Nonlinear Signal Processing	UE	2	2	
Signal Processing and Machine Learning 1	SE	3	2		Signal Processing and Machine Learning 1	SE	3.5	2	
Spoken Language in Human and Human-Computer Dialogue	VU	3.5	2		Spoken Language in Human and Human-Computer Dialogue	VU	3	2	
Measurement Electronics	VO	3	2		Measurement Signal Processing	VO	3	2	
Discrete-Time Control	VO	3	2		Image Based Measurement	VO	3	2	
Discrete-Time Control, Laboratory	LU	1.5	1		Image Based Measurement, Laboratory	LU	1.5	1	
Fundamentals of Photonics	VO	3	2		Photonic Sensors	VO	3	2	
Fundamentals of Photonics, Laboratory	LU	1.5	1		Photonic Sensors, Laboratory	LU	1.5	1	
Optimisation I	VU	3	2		Optimisation I	VO	3	2	
Advanced Telecommunications, Laboratory	LU	3	2		Communications Systems, Laboratory	LU	3	2	
Advanced Digital Communications	VO	3	2		Mobile Radio Systems	VO	3	2	
Mobile Computing, Seminar	SE	4.5	3		Mobile Computing, Seminar	SE	5	3	

New curriculum Information and Computer Engineering 2025					Expiring curriculum Information and Computer Engineering 2015 in the version 2020				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Estimation and Detection Theory for Communications	VO	3	2		Design of Digital Modems	VO	3	2	
Fundamentals of RF Measurement Techniques	VU	3	2		Microwave Measurement Techniques	VU	3	2	
Optoelectrical Communication Engineering	VO	4.5	3		Optische Nachrichtentechnik	VO	4.5	3	
Optoelectrical Communication Engineering	UE	1.5	1		Optische Nachrichtentechnik	UE	1.5	1	
Wireless Power Technologies for Sustainable Electronics	VO	3	2		RFID Systems	VO	3	2	
Multi-Sensor Data Fusion, Laboratory and 1.5 ECTS can be recognised for X_ELECT	LU	1.5	1		Multi-Sensor Data Fusion, Laboratory	LU	3	2	
Communication and Sensing Systems, Seminar	SE	2	1.5		Radar, Seminar	SE	2	1.5	
Electromagnetic Fields I	VO	3	2		Electrodynamics ICE	VO	3	2	
Electromagnetic Fields I	UE	3	2		Electrodynamics ICE	UE	1.5	1	
Fundamentals of Microelectronics	2	VO	3		Basics of Microelectronics	2	VO	3	
Practical Analog Circuit Design	2	UE	3		Dimensionierung elektronischer Schaltungen	2	UE	3	
Practical Analog Circuit Design, Laboratory	1	LU	1		Dimensioning of Electronic Circuits, Laboratory	1	LU	1	
Selected Topics of Electronics Systems and IC Design (Advanced Analog IC Design)	2	SE	3		Selected Topics of Advanced Analog IC Design	2	SE	3	
Fundamentals of RF & Microwave Engineering	2	VO	3		Grundlagen der Hochfrequenztechnik	2	VO	3	
Fundamentals of RF & Microwave Engineering	1	UE	1.5		Grundlagen der Hochfrequenztechnik	1	UE	2	
Analog RF Filter Design	2	VU	3		RF and Microwave Component Design	2	VU	3	
Other courses									
Business Administration	VO	4.5	3		Encyclopedia Business Economics	VO	4.5	3	
Business Administration	UE	2	2						

New curriculum Information and Computer Engineering 2025					Expiring curriculum Information and Computer Engineering 2015 in the version 2020				
Course	Course type	ECTS	SSt	Course	Course type	ECTS	SSt		
and 1 ECTS can be recognised for X_ELECT				Encyclopedia Business Economics	UE	3	2		
General rules for the allocation of courses for the modules MA_ELECT, MI and X_ELECT									
These courses can be allocated to one of the modules MA_ELECT_ISEC, MI_ISEC, or X_ELECT.				All courses in the Elective Module Catalogue C01 Information Security					
These courses can be allocated to one of the modules MA_ELECT_SWT, MI_SWT, or X_ELECT.				All courses in the Elective Module Catalogue C01a Software Technology					
These courses can be allocated to one of the modules MA_ELECT_VC, MI_VC, or X_ELECT.				All courses in the Elective Module Catalogue C02 Visual Computing					
These courses can be allocated to one of the modules MA_ELECT_AI, MA_ELECT_RO, MI_AI, MI_RO, or X_ELECT.				All courses in the Elective Module Catalogue C03 Robotics and Intelligent Systems					
These courses can be allocated to one of the modules MA_ELECT_SPHC, MI_SPHC, or X_ELECT.				All courses in the Elective Module Catalogue C04 Signal Processing and Human Communication					
These courses can be allocated to one of the modules MA_ELECT_CMC, MI_CMC, or X_ELECT.				All courses in the Elective Module Catalogue C05 Communications and Mobile Computing					
These courses can be allocated to one of the modules MA_ELECT_EAS, MI_EAS, or X_ELECT.				All courses in the Elective Module Catalogue C06 Embedded and Automotive Systems					
These courses can be allocated to one of the modules MA_ELECT_SCS, MI_SCS, or X_ELECT.				All courses in the Elective Module Catalogue C07 Measurement and Control Systems					
These courses can be allocated to one of the modules MA_ELECT_ME, MI_ME, or X_ELECT.				All courses in the Elective Module Catalogue C08 Microelectronics and IC Design					
These courses can be allocated to one of the module X_ELECT.				All courses in the Elective Module Catalogue S01 Supplementary Catalogue					
These courses can be allocated to one of the modules MI_BLM, or X_ELECT.				All courses in the Elective Module Catalogue W01 Business, Law, and Management					

New curriculum Information and Computer Engineering 2025					Expiring curriculum Information and Computer Engineering 2015 in the version 2020				
Course	Course type	ECTS	SSt	Course	Course type	ECTS	SSt		
General rules for the allocation of courses for the compulsory modules MA_COMP									
<p>Courses completed to fulfil the requirements are allocated to the corresponding module MA_COMP. The following allocations are possible:</p> <p>C01 -> MA_COMP_ISEC C01a -> MA_COMP_SWT C02 -> MA_COMP_VC C03 -> MA_COMP_AI or MA_COMP_RO C04 -> MA_COMP_SPHC C05 -> MA_COMP_CMC C06 -> MA_COMP_EAS C07 -> MA_COMP_SCS C08 -> MA_COM_ME</p>					<p>The completion of one of the elective subject catalogues C01, C01a, C02, C03, C04, C05, C06, C07, C08 fully meets the requirements for completing compulsory or elective subjects for a major.</p>				

(2) Regulations for continuing with the expiring Master's Degree Programme Information and Computer Engineering 2015 in the version of 2020

The courses of the expiring Master's Degree Programme Information and Computer Engineering are listed on the left-hand side of the table. On the right side of the table is a list of courses from the new curriculum that may be completed instead of the courses originally listed in the curriculum if the student wishes to remain in the expiring curriculum and the original courses are no longer offered.

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

Expiring curriculum Information and Computer Engineering 2015 in the version 2020					New curriculum Information and Computer Engineering 2025				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Courses at the Faculty of Computer Science and Biomedical Engineering									
Logic-Based Knowledge Representation	VU	4	3		Logic-Based Knowledge Representation	VU	4.5	3	
Reinforcement Learning and Reinforcement Learning	VO	3	2		Probabilistic Decision Making	VU	5	3	
	UE	2	1						
Seminar Cryptology and Privacy	SE	3.5	2		Mathematical Foundations of Cryptography	SE	3.5	2	
Virtual Reality	VU	7	4		Virtual Reality	VU	5	3	
Verification and Testing and Verification and Testing	VO	3	2		Verification and Model Checking	VU	5	3	
	UE	2	1						
Digital System Design and Digital System Design	VO	3	2		Hardware Design for Security	VU	5	3	
	KU	2	1						
Cryptanalysis and Cryptanalysis	VO	3	2		Cryptanalysis	VU	5	3	
	KU	3	1						
Secure Software Development and Secure Software Development	VO	3	2		Secure Software Development	VU	5	3	
	KU	2	1						
Basics in Artificial Intelligence and Logic	VU	3	2		Artificial Intelligence 2	VU	3	2	

Expiring curriculum Information and Computer Engineering 2015 in the version 2020					New curriculum Information and Computer Engineering 2025				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Courses at the Faculty of Electrical and Information Engineering									
Adaptive Systems	UE	2	1		Adaptive Systems	UE	1.5	1	
Nonlinear Signal Processing	UE	2	2		Nonlinear Signal Processing	UE	1.5	1	
Signal Processing and Machine Learning 1	SE	3.5	2		Signal Processing and Machine Learning 1	SE	3	2	
Spoken Language in Human and Human-Computer Dialogue	VU	3	2		Spoken Language in Human and Human-Computer Dialogue	VU	3.5	2	
Measurement Signal Processing	VO	3	2		Measurement Electronics	VO	3	2	
Image Based Measurement	VO	3	2		Discrete-Time Control	VO	3	2	
Image Based Measurement, Laboratory	LU	1.5	1		Discrete-Time Control, Laboratory	LU	1.5	1	
Photonic Sensors	VO	3	2		Fundamentals of Photonics	VO	3	2	
Photonic Sensors, Laboratory	LU	1.5	1		Fundamentals of Photonics, Laboratory	LU	1.5	1	
Optimisation I	VO	3	2		Optimisation I	VU	3	2	
Communications Systems, Laboratory	LU	3	2		Advanced Telecommunications, Laboratory	LU	3	2	
Mobile Radio Systems	VO	3	2		Advanced Digital Communications	VO	3	2	
Mobile Computing, Seminar	SE	5	3		Mobile Computing, Seminar	SE	4.5	3	
Design of Digital Modems	VO	3	2		Estimation and Detection Theory for Communications	VO	3	2	
Microwave Measurement Techniques	VU	3	2		Fundamentals of RF Measurement Techniques	VU	3	2	
Optische Nachrichtentechnik	VO	4.5	3		Optoelectrical Communication Engineering	VO	4.5	3	
Optische Nachrichtentechnik	UE	1.5	1		Optoelectrical Communication Engineering	UE	1.5	1	
RFID Systems	VO	3	2		Wireless Power Technologies for Sustainable Electronics	VO	3	2	
Multi-Sensor Data Fusion, Laboratory	LU	3	2		Multi-Sensor Data Fusion, Laboratory	LU	1.5	1	
Radar, Seminar	SE	2	1.5		Communication and Sensing Systems, Seminar	SE	2	1.5	
Electrodynamics ICE	VO	3	2		Electromagnetic Fields I	VO	3	2	
Electrodynamics ICE	UE	1.5	1		Electromagnetic Fields I	UE	3	2	
Basics of Microelectronics	2	VO	3		Fundamentals of Microelectronics	2	VO	3	
Dimensionierung elektronischer Schaltungen	2	UE	3		Practical Analog Circuit Design	2	UE	3	
Dimensioning of Electronic Circuits, Laboratory	1	LU	1		Practical Analog Circuit Design, Laboratory	1	LU	1	
Selected Topics of Advanced Analog IC Design	2	SE	3		Selected Topics of Electronics Systems and IC Design (Advanced Analog IC Design)	2	SE	3	

Expiring curriculum Information and Computer Engineering 2015 in the version 2020					New curriculum Information and Computer Engineering 2025				
Course	Course type	ECTS	SSt		Course	Course type	ECTS	SSt	
Grundlagen der Hochfrequenztechnik	2	VO	3		Fundamentals of RF & Microwave Engineering	2	VO	3	
Grundlagen der Hochfrequenztechnik	1	UE	2		Fundamentals of RF & Microwave Engineering	1	UE	1.5	
RF and Microwave Component Design	2	VU	3		Analog RF Filter Design	2	VU	3	
Other courses									
Encyclopedia Business Economics	VO	4.5	3		Business Administration	VO	4.5	3	
Encyclopedia Business Economics	UE	3	2		Business Administration	UE	2	2	
General rules for the allocation of courses to catalogues of electives									
These courses can be allocated to the catalogue of electives C01 Information Security					All courses in the Elective Module Catalogue Information Security (ISEC)				
These courses can be allocated to the catalogue of electives C01a Software Technology					All courses in the Elective Module Catalogue Software Technology (SWT)				
These courses can be allocated to the catalogue of electives C02 Visual Computing					All courses in the Elective Module Catalogue Visual Computing (VC)				
These courses can be allocated to the catalogue of electives C03 Robotics and Intelligent Systems					All courses in the Elective Module Catalogue Artificial Intelligence (AI) and the Elective Module Catalogue Robotics (RO)				
These courses can be allocated to the catalogue of electives C04 Signal Processing and Human Communication					All courses in the Elective Module Catalogue Signal Processing and Human Communication (SPHC)				
These courses can be allocated to the catalogue of electives C05 Communications and Mobile Computing					All courses in the Elective Module Catalogue Communications and Mobile Computing (CMC)				
These courses can be allocated to the catalogue of electives C06 Embedded and Automotive Systems					All courses in the Elective Module Catalogue Embedded and Automotive Systems (EAS)				
These courses can be allocated to the catalogue of electives C07 Measurement and Control Systems					All courses in the Elective Module Catalogue Sensing and Control Systems (SCS)				
These courses can be allocated to the catalogue of electives C08 Microelectronics and IC Design					All courses in the Elective Module Catalogue Microelectronics and IC Design (ME)				

Expiring curriculum Information and Computer Engineering 2015 in the version 2020				New curriculum Information and Computer Engineering 2025			
Course	Course type	ECTS	SSt	Course	Course type	ECTS	SSt
These courses can be allocated to the catalogue of electives W01 Business, Law, and Management				All courses in the Elective Module Catalogue Business, Law, and Management (BLM)			

