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# Curriculum

for the Master's degree programme

Information and Communications  
Engineering (ICE)

Degree programme code UL 066 488  
(Version 22W.1)

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# Curriculum for the Master's Degree Programme

## *Information and Communications Engineering (ICE)*

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## **§ 1 General Remarks**

- (1) The Master's degree programme Information and Communications Engineering (ICE) comprises 120 European Credit Transfer and Accumulation System (ECTS) credits. This corresponds to a scheduled study duration of 4 semesters. In accordance with § 54 Paragraph 1 of the Universities Act 2002 (hereafter: UA), the Master's degree programme Information and Communications Engineering is assigned to the group of Engineering Sciences programmes.
- (2) The workload for the individual achievement is indicated in ECTS credits. The workload must amount to 1500 hours in one year, for which 60 credits are awarded (Section 54 (2) UA). The workload is comprised of the element of independent study as well as the semester and contact hours, including participation in the assessment procedure.
- (3) The Master's degree programme Information and Communications Engineering offers three branches of study. Students select one of the three branches of study:
  - (a) Branch of study Networks and Communications (NC)
  - (b) Branch of study Autonomous Systems and Robotics (ASR)
  - (c) Branch of study Business and Engineering (BE)
- (4) The Master's degree programme is taught in English.

## **§ 2 Qualification Profile and Competences**

- (1) The qualification profile describes the academic and professional qualifications that students acquire by completing the degree programme.
- (2) Information technology is one of the crucial drivers of technical and economic development in Europe and across the globe. Information technology systems shape our daily working and private lives. We work on the laptop computer and the PC, listen to music on the MP3 player, and are globally networked through the Internet and the mobile telephone. When we are on the move, systems such as driver assistance in the car or automatic passenger information on local public transport provide support. Medical clinics are furnished with high-tech equipment for the diagnosis and treatment of injuries and diseases.

In the industrial sector, robots assemble complicated devices, and networked sensors monitor chemical processes. The term "information technology" refers to any instance that involves information being produced, processed, transported, stored, and issued using technical means. In this context, information can take many forms, e.g. voice data, images, videos or measurement data.

Information technology can also make a significant contribution to sustainable development, for example in environmental measurement technology, in the optimisation of energy supply and energy use or in the development of methods and procedures to reduce resource consumption or emissions of all kinds through prevention strategies (non-destructive, non-invasive testing methods and quality assurance, improvement of maintenance or servicing systems, support of regional and seasonal supply strategies, including the field of agriculture, medical care, climate protection measures, etc.).

Increasingly, information technology systems are also disappearing into objects of everyday use—they are quite literally “embedded” there, turning them into “intelligent objects”, which imperceptibly assist humans in their activities. The terms “Ambient Intelligence”, or “Pervasive Computing and Communications”, and the “Internet of Things” are also used in this context. This is also reflected in the development of information technology, which is becoming an interdisciplinary discipline for other key technologies such as, for instance, medical engineering, nanotechnology and biotechnology.

In addition to the technical components, economic aspects are also of great significance for the success of innovations in information technology. This fact is accounted for by the inclusion of the separate branch of study “Business and Engineering” within the Master’s degree programme Information and Communications Engineering.

The creation of innovations in the sphere of information technology requires highly trained and creative engineers. They develop new ideas and products, and they offer services that make life simpler and more efficient thanks to modern information and communications technology, and that also help to make the world a little bit smaller. However, continuous and rapid change is also a typical characteristic of the field of information technology. New knowledge and current products can very quickly become obsolete. This is why there is a great demand for engineers who have received a broad and well-founded education, and who are skilled at thinking analytically and grasping complex interrelationships.

The range of information technology degree programmes offered at the University of Klagenfurt conveys the required skills and abilities. There are three engineering degrees: the classic Bachelor’s degree programme in Information Technology, the English-language Bachelor’s degree programme in Robotics and Artificial Intelligence and the Master’s degree programme in Information and Communications Engineering. The latter leads to the academic degree of Diplom-Ingenieur (Austrian university degree equivalent to Master of Engineering). Based on sound mathematical and technical foundations, the consecutive pursuit of the two degree programmes delivers the expertise, skills and methodologies necessary for professional engineering activities. In addition to providing broad fundamental knowledge about the field, particular in-depth focus is placed on one particular area of information technology. The range of available courses, laboratories, and research and industry placements reinforces the practical relevance of the degree programmes. The technical content is supplemented by non-technical subjects designed to expand competencies and strengthen soft skills. The consideration of gender aspects helps to prepare graduates to make a substantial contribution to meeting the societal challenges posed by a society in transition to becoming more humane and gender-equitable.

Graduates completing the Master’s degree programme Information and Communications Engineering can work as developers of technical systems, or as product managers for suppliers to the automobile industry, chip manufacturers, consultancies, software companies, and medical engineering businesses, to name a few examples. Business engineers typically hold professional functions in the sphere of corporate planning, production management, logistics, sales and marketing, as well as the rationalisation and restructuring of organisational processes. In view of the current

exigencies of the internationally focused and increasingly networked area of production and service management, there is a particularly high demand for the interdisciplinary skill set of the business engineer, who can tackle technical problems in an integrative and consistent manner.

Extending beyond the fundamentals of the Bachelor's degree programme, graduates of the Master's degree programme Information and Communications Engineering at Klagenfurt University gain broad professional expertise and skills, as well as a scientific foundation in at least one branch of information technology (learning outcomes):

- **Professional skills and knowledge of the current state of the art in a branch of information technology:** Strongly research-led teaching in one of the branches of study available for selection by students introduces them to the state of the art in research and technology and empowers them to work scientifically in the chosen field in the context of their Master's thesis.
- **Individual and leadership competences:** Specially designed courses allow students to prepare for scientific work. In the light of the graduates' international occupational field and in order to reinforce their language skills, the courses in the Master's degree programme are taught in English; students are further encouraged to write their master thesis in English. Gender knowledge and gender skills can be acquired by attending courses in the elective subject Feminist Science / Gender Studies (§ 9 Para. 2).
- **Practical or research experience and problem-solving skills:** Students are offered the opportunity to gather comprehensive project-related work experience in the course of a research or industry placement. This provides intensive practical experience or impressions and experiences in research projects. Thus, graduates expand their expertise for solving large-scale problems in the field of business or administration, or for dealing with research questions in the academic sphere.
- **Scientific working methods:** Students deliver their first scientific contributions in the form of the research project and the Master's thesis, and are thus acquainted with working in a scientific manner. Graduates are qualified to pursue a doctoral degree.

### (3) Branch of study Networks and Communications (NC)

The branch of study Networks and Communications serves to provide an academic education and qualification for professional activities in the development and operation of modern information and communication technologies, which require the application of scientific insights and methods. The course content encompasses both sound theoretical principles and practically relevant methodology. Furthermore, this branch of study provides the opportunity to gain expertise in areas of specialization, e.g. in the fields of embedded and ubiquitous systems, mobile and wireless networks, and self-organizing systems with applications in the areas of mobility and energy.

(4) Branch of study Autonomous Systems and Robotics (ASR)

The branch of study Autonomous Systems and Robotics serves to provide an academic education and qualification for professional activities in the development and operation of autonomous systems, which interact with their environment through mechatronic components, as well as covering the required scientific insights and methods. The course content encompasses both sound theoretical principles and practically relevant methodology. Furthermore, this branch of study provides the opportunity to gain expertise in areas of specialization, e.g. in the fields of autonomous robotics, driving assistance systems, self-propelled cars, networked sensor and actuator technology, networked control systems engineering and intelligent production systems.

(5) Branch of study Business and Engineering (BE)

The branch of study Business and Engineering serves to provide an academic education and qualification for persons, who can combine technical expertise with sound economic judgment. The programme content focuses particularly on the application of integrated thinking to the analysis of problems and to the development of solutions to economic problems, which require the implementation of scientific insights and methods. Business engineers are expected, in particular, to establish connections between the discipline-specific modes of thinking and working, and are deployed to great effect in companies or organisations that deal with technological solutions from an economic perspective. Consequently, business engineers have access to a very broad occupational field.

### **§ 3 Admission Requirements**

- (1) The admission to a Master's degree programme is conditional upon the completion of a relevant Bachelor's degree programme or another relevant degree programme of at least the same higher education level from a recognised domestic or foreign post-secondary educational institution or a degree programme specified in the curriculum of the Master's degree programme. In order to compensate for substantial subject-related differences, supplementary examinations may be prescribed, which must be completed by the end of the second semester of the Master's degree programme. The Rectorate may determine which of these supplementary examinations are prerequisites for taking examinations prescribed in the curriculum of the Master's degree programme (§ 64 Para. 3 UA).
- (2) The Bachelor's degree programmes in Information Technology and Robotics & Artificial Intelligence at the University of Klagenfurt qualify as relevant in any case.
- (3) Students who are not able to prove that they have completed the required fundamentals of economics (especially the courses in the subject "Fundamentals of Economics" within the Bachelor's degree programme in Information Technology) have the option of completing the branch of study Business and Engineering. These students must complete the missing fundamentals of economics in consultation with the

Programme Director within the context of the guided electives “3.3b Management and Economics: Basic Courses” and “3.5 Soft Skills” (c.f. § 9).

- (4) Persons whose first language is not English are required to demonstrate proficiency in English at level B2 of the Common European Framework of Reference for Languages (CEFR).

#### § 4 Academic Degree

Graduates of this Master’s degree programme are awarded the academic degree “Diplom-Ingenieurin/Diplom-Ingenieur” (abbreviated to “Dipl.-Ing.” or “DI” and equivalent to “Master of Engineering”). When used, the academic degree must precede the name.

#### § 5 Structure and Organisation of the Degree Programme

Table 1: Structure of the programme in the branch of study Networks and Communications Engineering (NC)

| Subject/<br>academic<br>performance | Designation |  | Intended Learning Outcomes  | ECTS<br>credits |
|-------------------------------------|-------------|--|---|-----------------|
| <b>Compulsory<br/>Subjects</b>      | 1.1         | Networks and<br>Communications:<br>Fundamentals  | After successfully completing the subject, students are able to <ul style="list-style-type: none"> <li>- present and explain basic methodological principles in the field of the branch of study Networks and Communications;</li> <li>- compare and contrast advantages and disadvantages of different communication technologies;</li> <li>- identify characteristics of specific communications networks and applications (e.g. mobile communication, sensor networks, Internet of Things).</li> </ul> | 12              |
|                                     | 1.2         | Networks and<br>Communications:<br>Advanced      | After successfully completing the subject, students are able to <ul style="list-style-type: none"> <li>- apply skills acquired in 1.1 to practical tasks;</li> <li>- select and adapt suitable methods and technologies for various types of network architecture;</li> <li>- research, discuss and present the state of the art in one subsection of the subject.</li> </ul>   | 30              |
|                                     | 1.3         | Information and<br>Communications<br>Engineering | After successfully completing the subject, students are able to   | 18              |

|                                    |     |                          |   |            |
|------------------------------------|-----|--------------------------|---|------------|
|                                    |     | (ICE):<br>Supplements    | - deepen and/or broaden personal professional competences according to their individual interests.  |            |
|                                    | 1.4 | Technical<br>Complements | After successfully completing the subject, students are able to<br><br>- deepen personal professional competences according to their individual interests and/or extend them beyond their own field of expertise;<br><br>- develop problem-solving solutions for scientific problems under expert supervision;<br><br>- prepare a report detailing the results of research activities.                                      | 12         |
|                                    | 1.5 | Soft Skills              | After successfully completing the subject, students are able to<br><br>- to expand personal competences in a targeted manner according to their own interests, especially with regard to soft skills, gender studies, sustainable development and technology assessment.  | 12         |
| <b>Open Electives</b>              | 1.6 | Open Electives           | Students acquire individually chosen additional competences.  | 6          |
| <b>Master's Thesis</b>             | 1.7 |                          | After successfully completing the subject, students are able to<br><br>- research and discuss the state of the art in one subsection of the subject;<br><br>- identify specific problems within the state of the art;<br><br>- design problem-solving approaches for specific problems;<br><br>- implement and validate problem-solving approaches;<br><br>- prepare a report detailing the results of research activities. | 24         |
| <b>Master's Thesis Supervision</b> | 1.8 |                          |   | 3          |
| <b>Final Board Examination</b>     | 1.9 |                          |   | 3          |
| <b>Total:</b>                      |     |                          |   | <b>120</b> |



Table 2: Structure of the programme in the branch of study Autonomous Systems and Robotics (ASR)

| Subject/<br>academic<br>performance | Designation |   | Intended Learning Outcomes   | ECTS<br>credits |
|-------------------------------------|-------------|---|--|-----------------|
| <b>Compulsory<br/>Subjects</b>      | 2.1         | Autonomous<br>Systems and<br>Robotics:<br>Fundamentals                    | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- present and explain basic methodological principles in the field of Autonomous Systems and Robotics;</li> <li>- explain fundamental concepts and methods for the control systems engineering of networked systems;</li> <li>- identify advantages and disadvantages of different sensor and actuator technologies in a variety of application settings;</li> <li>- identify special requirements with regard to sensor technology, actuator technology and control systems engineering.</li> </ul> | 12              |
| <b>Guided Electives</b>             | 2.2         | Autonomous<br>Systems and<br>Robotics:<br>Advanced                        | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- apply skills acquired in 2.1 to practical tasks;</li> <li>- select and adapt suitable methods and technologies for autonomous systems or robotics applications;</li> <li>- research, discuss and present the state of the art in one subsection of the subject.</li> </ul>   | 30              |
|                                     | 2.3         | Information and<br>Communications<br>Engineering<br>(ICE):<br>Supplements | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- deepen and/or broaden personal professional competences according to their individual interests.</li> </ul>  | 18              |
|                                     | 2.4         | Technical<br>Complements  | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- deepen personal professional competences according to their individual interests and/or extend them beyond their own field of expertise;</li> </ul>  | 12              |

|                                    |     |   |   |            |
|------------------------------------|-----|---|---|------------|
|                                    |     |   | <ul style="list-style-type: none"> <li>- develop problem-solving solutions for scientific problems under expert supervision;</li> <li>- prepare a report detailing the results of research activities.</li> </ul>   |            |
|                                    | 2.5 | Soft Skills                                       | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- to expand personal competences in a targeted manner according to their own interests, especially with regard to soft skills, gender studies, sustainable development and technology assessment.</li> </ul>  | 12         |
| <b>Open Electives</b>              | 2.6 | Open Electives                                    | Students acquire individually chosen additional competences.  | 6          |
| <b>Master's Thesis</b>             | 2.7 | Master's Thesis incl. Master's Thesis Supervision | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- research and discuss the state of the art in one subsection of the subject;</li> <li>- identify specific problems within the state of the art;</li> <li>- design problem-solving approaches for specific problems;</li> <li>- implement and validate problem-solving approaches;</li> <li>- prepare a report detailing the results of research activities.</li> </ul> | 24         |
| <b>Master's Thesis Supervision</b> | 2.8 |   |   | 3          |
| <b>Final Board Examination</b>     | 2.9 |   |   | 3          |
| <b>Total:</b>                      |     |   |   | <b>120</b> |

Table 3: Structure of the programme in the branch of study Business and Engineering (BE)

| Subject/<br>academic<br>performance | Designation |   | Intended Learning Outcomes   | ECTS<br>credits |
|-------------------------------------|-------------|---|--|-----------------|
| <b>Compulsory<br/>Subjects</b>      | 3.1         | Management<br>and<br>Economics:<br>Fundamentals               | After successfully completing the subject,<br>students are able to<br><br>- present and explain knowledge of the<br>professional and methodological<br>foundations of decision-oriented business<br>administration and the relevant areas of<br>economics.   | 8               |
|                                     | 3.2         | Management<br>and<br>Economics:<br>Advanced                   | After successfully completing the subject,<br>students are able to<br><br>- apply skills acquired in 3.1 to practical<br>tasks;<br><br>- select suitable methods and processes for<br>problem analysis;<br><br>- develop and evaluate solutions to<br>problems in the fields of<br>Entrepreneurship & Innovation<br>Management, Operational Management &<br>Supply Chain Management, Organisational<br>Control & Strategic Management as well<br>as Sustainable Development. | 24              |
| <b>Guided Electives</b>             | 3.3a        | Management<br>and Law:<br>Complements <sup>1</sup>            | After successfully completing the subject,<br>students are able to<br><br>- deepen and/or broaden personal<br>professional competences according to<br>their individual interests.   | 8               |
|                                     | or          |   |  |                 |
|                                     | 3.3b        | Management<br>and<br>Economics:<br>Basic Courses <sup>2</sup> | Students acquire fundamental knowledge<br>required to complete subjects 3.1 and<br>3.2.  |                 |
|                                     | 3.4a        | Networks and<br>Communicatio<br>ns                            | - see descriptions for 1.1 and 1.2   | 38              |

<sup>1</sup> This only applies to students who can demonstrate appropriate prior knowledge in Business Administration in accordance with § 3 Para. 3.

<sup>2</sup> This only applies to students who cannot demonstrate appropriate prior knowledge in Business Administration in accordance with § 3 Para. 3.

|                                    |      |   |   |            |
|------------------------------------|------|---|---|------------|
|                                    | or   |   |   | 6          |
|                                    | 3.4b | Autonomous Systems and Robotics                   | - see descriptions for 2.1 and 2.2  |            |
|                                    | 3.5  | Soft Skills <sup>3</sup>                          | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- to expand personal competences in a targeted manner according to their own interests, especially with regard to soft skills, gender studies, sustainable development and technology assessment;</li> <li>- develop problem-solving solutions for scientific problems under expert supervision;</li> <li>- prepare a report detailing the results of research activities.</li> </ul> |            |
| <b>Open Electives</b>              | 3.6  | Open Electives                                    | Students acquire individually chosen additional competences.  | 6          |
| <b>Master's Thesis</b>             | 3.7  | Master's Thesis incl. Master's Thesis Supervision | <p>After successfully completing the subject, students are able to</p> <ul style="list-style-type: none"> <li>- research and discuss the state of the art in one subsection of the subject;</li> <li>- identify specific problems within the state of the art;</li> <li>- design problem-solving approaches for specific problems;</li> <li>- implement and validate problem-solving approaches;</li> <li>- prepare a report detailing the results of research activities.</li> </ul>               | 24         |
| <b>Master's Thesis Supervision</b> | 3.8  |   |   | 3          |
| <b>Final Board Examination</b>     | 3.9  |   |   | 3          |
| <b>Total:</b>                      |      |   |   | <b>120</b> |

<sup>3</sup> Students who are not able to demonstrate relevant prior knowledge of Business Management in accordance with § 3 Para. 3 must select additional courses from 3.3b "Management and Economics: Basic Courses".

## § 6 Studying Abroad/Mobility

- (1) All students of the Master's degree programme are strongly encouraged to complete a degree-related period of study abroad as part of their studies. In particular, attention is drawn to the possibility of gaining practical experience abroad. For this purpose, students can take advantage of transnational EU, state or university mobility programmes. Examinations and other academic achievements completed as part of a study-related stay abroad will be recognised in lieu of examinations and academic achievements prescribed in the curriculum in accordance with the provisions pursuant to Section 78 of the Universities Act. The recommended mobility window is the 2<sup>nd</sup> or 3<sup>rd</sup> semester.
- (2) The Master's degree programme Information and Communications Engineering can be completed as a joint study programme according to § 54d UA in the form of a double degree programme in cooperation with the Università degli studi di Udine. Students who wish to complete the double degree programme must complete at least 30 ECTS credits at the Università degli studi di Udine.<sup>4</sup>
- (3) Upon application by regular degree students who wish to pursue portions of their studies abroad, an official decision shall be issued in advance to determine which of the planned examinations and other academic achievements are eligible for recognition (§ 78 Para. 5 UA). In any case, interested students are advised to contact the relevant Programme Director in advance regarding the prospective and intended recognition.

## § 7 Types of Courses

- (1) Lectures (VO) are courses in which the instructors convey knowledge by lecturing. The course is concluded with a single (written and/or oral) examination.
- (2) (2) Courses with an immanent examination character are courses in which the assessment is not based on a single examination, but rather is based on the written and/or oral contributions of the participants. If a seminar paper or a paper requiring comparable effort is required within the framework of an examination-immanent course, the paper may be submitted until the following 30 June for courses in the winter semester and until 31 January of the following year for courses in the summer semester.
- (3) The following are courses with an immanent examination character:
  - a) Lecture with course (VC): Courses of this type are comprised of a lecture part and a course part, which have close didactic links and are assessed jointly.
  - b) Course (KS): These are courses in which students and instructors work together on the subject matter in an experience-based and application-oriented way. In particular, courses serve to convey and expand skills required to solve specific problems.

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<sup>4</sup> Information on other double degree programmes is available from the Programme Director and the International Office.

- c) Seminar (SE): Seminars serve the purpose of reflection and discussion of specific scientific problems and/or scientific papers. Participants make their own written and oral contributions. Seminar papers must be produced independently and must comply with good scientific practise in terms of form and content.
- d) Research Seminar / Privatissimum (PV): A Privatissimum is a specially designed research seminar, which serves to prepare students for the Master's thesis or which provides guidance throughout the process of writing the Master's thesis.

For courses adopted from other curricula, the definitions of the respective curricula apply.

## § 8 Compulsory Subjects

- (1) Compulsory subjects lend the degree programme its distinctive character and are concluded by an examination. The courses included in the compulsory subjects comprise 12 ECTS credits each for the branches of study Networks and Communications and Autonomous Systems and Robotics, and 8 ECTS credits for the branch of study Business and Engineering.
- (2) The courses required for the compulsory subjects can be found in the following table:

*Table 4: Compulsory subjects within the different fields of study*

|  | Course title |                                      | Type of course | ECTS credits |
|--|--------------|--------------------------------------|----------------|--------------|
| Compulsory Subject Networks and Communications: Fundamentals     | 1.1          | Mobile Communications                | VC             | 4            |
|  |              | Signal Processing for Communications | VC             | 4            |
|  |              | Sensor Networks                      | VC             | 4            |
|  |              |                                      | <b>Total:</b>  | <b>12</b>    |
| Compulsory Subject Autonomous Systems and Robotics: Fundamentals | 2.1          | Robotics Fundamentals                | VC             | 4            |
|  |              | Sensors and Actuators                | VC             | 4            |
|  |              | Control of Autonomous Systems        | VC             | 4            |
|  |              |                                      | <b>Total:</b>  | <b>12</b>    |
| Compulsory Subject Management and Economics: Fundamentals        | 3.1          | Value based Management               | VC             | 2            |
|  |              | Operations Management and Logistics  | VC             | 2            |
|  |              | Energy Economics: Theory and Policy  | VO             | 4            |
|  |              |                                      | <b>Total:</b>  | <b>8</b>     |

## § 9 Guided Electives

(1) Guided electives are the subjects that students can choose according to the provisions of the curriculum. Overall, students must complete guided electives amounting to 76 resp. 72 ECTS credits.

The three possible guided elective combinations to be chosen correspond to the three branches of study:

- a) The guided electives (amounting to 72 ECTS credits) of the branch of study Networks and Communications Engineering are described in Table 5.
- b) The guided electives (amounting to 72 ECTS credits) of the branch of study Autonomous Systems and Robotics are described in Table 6.
- c) The guided electives (amounting to 76 ECTS credits) of the branch of study Business and Engineering are described in Table 7.

(2) The guided electives of the individual branches of study can be found in the following tables:

*Table 5: Guided electives of the branch of study Networks and Communications*

|  | Course title |  | Type of course | ECTS credits |
|--|--------------|--|----------------|--------------|
| <b>Networks and Communications: Advanced</b>                   | 1.2          | Courses amounting to 30 ECTS credits selected from the following list <sup>5</sup> :                                 |                |              |
|  |              | Advanced Wireless Communications   | VC             | 4            |
|  |              | Information Theory   | VC             | 4            |
|  |              | Mobile Communications  | KS             | 3            |
|  |              | Pervasive Computing  | VC             | 4            |
|  |              | Power Line Communications  | VC+KS          | 4+3          |
|  |              | Sensor Networks  | KS             | 3            |
|  |              | Signal Processing for Communications   | KS             | 3            |
|  |              | Simulation of Networked Systems  | VC             | 4            |
|  |              | Smart Grids  | VC             | 4            |
|  |              | Wireless Networks  | VC+KS          | 4+3          |
|  |              | <b>Total:</b>  | <b>30</b>      |              |
| <b>Information and Communications Engineering: Supplements</b> | 1.3a         | Research seminar from an area of Information Technology  | SE             | 4            |
|  | 1.3b         | Selected courses from 1.2 “Networks and Communications: Advanced” or 2.2 “Autonomous Systems and Robotics: Advanced” | VC/KS          | 14           |
|  |              | Selected courses from the following list <sup>5</sup> :  |                |              |
|  |              | Artificial Vision  | VC             |              |
|  |              | Fundamentals of Image Processing   | VC+KS          |              |

<sup>5</sup> Any surplus ECTS credits are allocated to the open electives.

|                              |   |   |               |               |
|------------------------------|---|---|---------------|---------------|
|                              |   | Mobile Applications with Android and iOS  | VC            |               |
|                              |   | Modeling and Simulation of Energy Systems   | VC            |               |
|                              |   | Pervasive Computing Lab   | KS            |               |
|                              |   |   | <b>Total:</b> | <b>18</b>     |
| <b>Technical Complements</b> | 1.4a  | Choice of relevant courses from the field of Computer Science <sup>6</sup>  |               | 6/12          |
|                              |   | Choice of relevant courses from the field of Mathematics <sup>6</sup>   |               |               |
|                              |   | Selected courses from 1.2 “Networks and Communications: Advanced” or 2.2 “Autonomous Systems and Robotics: Advanced” or 1.3b “ICE-Supplements”  | VC/KS         |               |
|                              | 1.4b  | Research placement: Research project from an area of Information Technology   | KS            | 6/0           |
|                              | or<br>Industry placement: Research seminar to accompany the placement | PV  |               |               |
|                              |   |   | <b>Total:</b> | <b>12</b>     |
| <b>Soft Skills</b>           | 1.5   | Selected courses from the following areas: <ul style="list-style-type: none"> <li>• Feminist Science / Gender Studies</li> <li>• Sustainable Development</li> <li>• Writing Sciences</li> <li>• Language</li> <li>• Technology Assessment</li> <li>• Business Administration</li> </ul> |               | 12            |
|                              |   |   |               | <b>Total:</b> |

Table 6: Guided electives of the branch of study Autonomous Systems and Robotics

|  | Course title | Type of course   | ECTS credits |     |
|--|--------------|--|--------------|-----|
| <b>Autonomous Systems and Robotics: Advanced</b> | 2.2          | Courses amounting to 30 ECTS credits selected from the following list <sup>7</sup> : |              |     |
|  |              | CAE of Mechatronics Systems  | VC+KS        | 4+3 |
|  |              | Control of Autonomous Systems  | KS           | 3   |
|  |              | Data Mining and Neurocomputing   | VC           | 4   |
|  |              | Lab Robotics Fundamentals  | KS           | 4   |
|  |              | Measurement Signal Processing  | VC+KS        | 4+3 |
|  |              | Nonlinear Systems: Analysis and Control  | VC+KS        | 4+3 |

<sup>6</sup> Students can only choose courses from the other curriculum if their contents clearly reach beyond the contents of the courses of the compulsory subjects and guided electives of the Master’s curriculum ICE. Students are advised to complete courses that build on each other in the intended order.

<sup>7</sup> Any surplus ECTS credits are allocated to the open electives.



|                              |      |   |               |           |
|------------------------------|------|---|---------------|-----------|
|                              |      | Robust Design and Reliability   | VC+KS         | 4+3       |
|                              |      | Sensors and Actuators   | KS            | 3         |
|                              |      | Vision Based State Estimation and Sensor Fusion   | VC+KS         | 4+3       |
|                              |      |   | <b>Total:</b> | <b>30</b> |
| <b>ICE- Supplements</b>      | 2.3a | Research seminar from an area of Information Technology   | SE            | 4         |
|                              | 2.3b | Selected courses from 1.2 “Networks and Communications: Advanced” or 2.2 “Autonomous Systems and Robotics: Advanced”  | VC/KS         | 14        |
|                              |      | Selected courses from the following list <sup>7</sup> :   |               |           |
|                              |      | Artificial Vision   | VC            |           |
|                              |      | Fundamentals of Image Processing  | VC+KS         |           |
|                              |      | Mobile Applications with Android and iOS  | VC            |           |
|                              |      | Modeling and Simulation of Energy Systems   | VC            |           |
|                              |      | Pervasive Computing Lab   | KS            |           |
|                              |      |   | <b>Total:</b> | <b>18</b> |
| <b>Technical Complements</b> | 2.4a | Choice of relevant courses from the field of Computer Science <sup>8</sup>  |               | 6/12      |
|                              |      | Choice of relevant courses from the field of Mathematics <sup>8</sup>   |               |           |
|                              |      | Selected courses from 1.2 “Networks and Communications: Advanced” or 2.2 “Autonomous Systems and Robotics: Advanced” or 1.3b “ICE-Supplements”  | VC/KS         |           |
|                              | 2.4b | Research placement: Research project from an area of Information Technology   | KS            | 6/0       |
|                              |      | or<br>Industry placement: Research seminar to accompany the placement   | PV            |           |
|                              |      |   | <b>Total:</b> | <b>12</b> |
| <b>Soft Skills</b>           | 2.5  | Selected courses from the following areas: <ul style="list-style-type: none"> <li>• Feminist Science / Gender Studies</li> <li>• Sustainable Development</li> <li>• Writing Sciences</li> <li>• Language</li> <li>• Technology Assessment</li> <li>• Business Administration</li> </ul> |               | 12        |
|                              |      |   | <b>Total:</b> | <b>12</b> |

<sup>8</sup> Students can only choose courses from the other curriculum if their contents clearly reach beyond the contents of the courses of the compulsory subjects and guided electives of the Master’s curriculum ICE. Students are advised to complete courses that build on each other in the intended order.

Table 7: Guided electives of the branch of study Business and Engineering

|   | Course title  |   | Type of course | ECTS credits |
|---|---|---|----------------|--------------|
| <b>Management and Economics: Advanced</b>                   | Choice of 2 of the 4 course bundles. Students must complete 12 ECTS credits from each of the selected bundles |   |                |              |
|   | 3.2a  | Entrepreneurship & Innovation Management  |                | 12           |
|   | 3.2b  | Operational management & Supply Chain Management  |                | 12           |
|   | 3.2c  | Organisational Control and Strategic Management   |                | 12           |
|   | 3.2e  | Sustainable Development   |                | 12           |
|   |   |   | <b>Total:</b>  | <b>24</b>    |
| <b>Management and Law: Complements<sup>9</sup></b>          | 3.3a  | Selection of further courses from “Management and Economics: Advanced” not previously selected under 3.2a - f   |                | 8            |
|   |   | Choice of relevant courses from the Master’s degree programme “International Management” <sup>10</sup>  |                |              |
|   |   | Choice of courses from the Master’s degree programme “Business and Law” <sup>10</sup>   |                |              |
|   | <b>Or</b>   |   |                |              |
| <b>Management and Economics: Basic Courses<sup>11</sup></b> | 3.3b  | Selection of courses from the compulsory subjects “Principles of Business” and/or “Principles of Economics” from the Bachelor’s degree programme “International Business and Economics (IBEC)”. |                |              |
|   |   |   | <b>Total:</b>  | <b>8</b>     |
| <b>Networks and Communications</b>                          | 3.4a  | Choice of courses from 1.1 “Networks and Communications: Fundamentals” and 1.2 “Networks and Communications: Advanced”  |                | 38           |
|   | <b>Or</b>   |   |                |              |
| <b>Autonomous Systems and Robotics</b>                      | 3.4b  | Choice of courses from 2.1 “Autonomous Systems and Robotics: Fundamentals” and 2.2 “Autonomous Systems and Robotics: Advanced”  |                |              |
|   |   |   | <b>Total:</b>  | <b>38</b>    |
| <b>Soft Skills<sup>12</sup></b>                             | 3.5a  | Selected courses from the following areas: <ul style="list-style-type: none"> <li>Feminist Science / Gender Studies</li> </ul>  |                |              |

<sup>9</sup> Only for those students who can demonstrate corresponding previous knowledge in Business Administration according to § 3 Para. 3. Courses that have already been completed as part of the Bachelor’s degree programme required for admission cannot be used for the Master’s degree programme.

<sup>10</sup> Students can only choose courses from the other curriculum if their contents clearly reach beyond the contents of the courses of the compulsory subjects and guided electives of the Master’s curriculum ICE. Students are advised to complete courses that build on each other in the intended order.

<sup>11</sup> Only those students who cannot demonstrate corresponding previous knowledge in Business Administration according to § 3 Para. 3.

<sup>12</sup> Students who cannot demonstrate corresponding prior knowledge in Business Administration according to § 3 Para. 3 must select additional courses from 3.3b “Management and Economics: Basic Courses”.

|  |      |  |               |          |
|--|------|--|---------------|----------|
|  |      | <ul style="list-style-type: none"> <li>• Sustainable Development</li> <li>• Writing Sciences</li> <li>• Language</li> <li>• Technology Assessment</li> </ul> |               | 6        |
|  | or   |  |               |          |
|  | 3.5b | Optional research or industry placement  | PV/KS         |          |
|  |      |  | <b>Total:</b> | <b>6</b> |

### § 10 Open Electives

- (1) The term *Open Electives* describes those subjects, which students can select freely from the range of courses offered by recognised domestic and foreign post-secondary educational institutions. Courses completed in order to gain the entitlement to study at a university, or the general or special university entrance qualification, are excluded.
- (2) In the case of courses completed at other recognised domestic or foreign post-secondary educational institutions, the respective competent Programme Director decides whether a recognition in lieu of the free electives of the chosen degree programme makes sense academically or with regard to professional activities.
- (3) Students must complete Open Electives amounting to 6 ECTS credits.

### § 11 Courses with Limited Numbers of Participants

- (1) The maximum number of participants permitted on each of the following courses is as follows:
  - Lecture with course: 30
  - Course: 30
  - Course (KS) in the form of a lab with classic lab character; in particular when it is necessary to work with/on equipment in the lab: 12
  - Seminar: 30
  - Research seminar / Privatissimum: 30

For courses from other curricula, the maximum numbers found in the respective curricula apply.

- (2) If the number of applications for these courses exceeds the number of places available, students will be accepted in accordance with the following procedure:
  - a) Students whose curriculum stipulates the course in question as a compulsory subject or as a guided elective are given priority admission.
  - b) In the event that the number of registrations still exceeds the number of places available, the ranking will be based on the ECTS credits already acquired in the curriculum that defines the course in question as a compulsory subject or guided elective. A higher total amount will be ranked preferentially.

## **§ 12 Master's Thesis**

- (1) The Master's thesis is the academic paper that demonstrates the student's ability to achieve adequate standards of content and methodology when independently addressing scholarly topics. The assignment for the Master's thesis shall be chosen in such a way that it is reasonable to expect a student to complete it within six months. A number of students may jointly address a topic, provided that the performance of individual students can be assessed.
- (2) The topic of the Master's thesis must be chosen from or assigned to one of the compulsory subjects (according to § 8) of the two branches of study Networks and Communications or Autonomous Systems and Robotics. In the branch of study Business and Engineering the topic of the Master's thesis can also be chosen from the compulsory subject of this branch, or be classified as relevant to it.
- (3) The Master's thesis including the relevant Privatissimum research seminar (worth 3 ECTS credits) accounts for 27 ECTS credits.
- (4) According to Statute B § 18 Para. 4 and 2a, the topic and the supervisor of the Master's thesis must be approved by the Rector of Studies. The application must be submitted before work commences. A change of supervisor is permitted until the time of submission of the Master's thesis. In justified individual cases (interdisciplinary focus of the topic), supervision by two persons who are authorised to supervise is permissible.
- (5) The completed Master's thesis must be submitted to the Rector of Studies in electronic format. On the request of the supervisor, the author must provide them with a bound copy of the thesis. The supervisor has two months from the date of submission to assess the Master's thesis.

## **§ 13 Provisions Regarding the Completion of a Relevant Internship**

- (1) To reinforce the practical and research experience as well as their problem-solving skills, students can complete either a research or an industry placement (worth 6 ECTS credits respectively) as part of the guided elective "1.4/2.4 Technical Complements" (for the branches of study NC and ASR), or "3.5 Soft Skills" (for the branch of study BE).
- (2) During a research or industrial placement, students work on a project, defined in advance, under the expert supervision of a university lecturer. The industrial placement can be completed in a company, with a public administrative body, a non-profit organisation, or a non-university research institution. Research placements are completed at a university. The internship has a scope of 150 hours.
- (3) The industrial placement is assessed through the course "Privatissimum accompanying the placement" (6 ECTS credits), the assessment of the research placement is carried out through the respective "research project" course (6 ECTS credits).

## **§ 14 Use of Languages Other than English**

The courses and oral and written examinations for the Master's degree programme in Information and Communications Engineering are held and taken in English; the Master's thesis must be written in English. At the request of the student, examinations may be taken in a language other than English subject to the consent of the course instructor.

## **§ 15 Examination Regulations**

- (1) The Master's degree programme Information and Communications Engineering is concluded with the successful completion of the following parts:
  - a) the courses pertaining to the compulsory subjects, the guided electives and the open electives (§§ 8-10),
  - b) the Master's thesis and the accompanying Privatissimum research seminar acc. to § 13, as well as
  - c) the final board examination acc. to § 17 Para. 3.
- (2) The prerequisite for applying for the final board examination is the successful completion of the parts listed under Para. 1 a) and b).
- (3) The final board examination takes the form of an oral examination that generally lasts for one hour and is taken in front of an examination board comprising three people. The final board examination is worth 3 ECTS credits and includes the following
  - a) presentation and defence of the Master's thesis, and
  - b) an examination on one subject from the subjects 1.1 and 1.2 (for the branch of study NC) or from the subjects 2.1 and 2.2 (for the branch of study ASR) or from the subjects 3.1, 3.2 as well as 3.4a and 3.4b (for the branch of study BE).
- (4) Examinations that have already been used for the completion of studies regarded as prerequisites for admission cannot be used again to complete the programme of studies in the Master's degree programme.
- (5) In accordance with the Statute, the lecturer responsible for the course must inform the students about the respective examination and assessment modalities of the course before the beginning of each semester.
- (6) The provisions of the Statute of the University of Klagenfurt and the Universities Act, as amended from time to time, shall apply with regard to the administration and repetition of examinations.

## **§ 16 Effective Validity**

This curriculum comes into force on the 1st of October 2022 following formal announcement in the University Bulletin of the University of Klagenfurt, and applies to all students who commence their Master's degree programme from the winter semester 2022/23 onwards.

## **§ 17 Transitional Provisions**

Students who, at the time this curriculum version 22W.1 comes into force, are subject to the Master's curriculum Information and Communications Engineering Version 15W in force prior to the enactment of this curriculum, are entitled to complete their studies according to the provisions of the curriculum version 15W within 5 semesters. If the degree programme is not completed by 31 March 2025, students shall be bound by the curriculum for the Master's degree programme in Information and Communications Engineering as applicable at that time.

Students following the previously valid curriculum are entitled to transfer to the newly valid curriculum at any time.

## APPENDIX 1 Equivalence Table

The specific provisions on the equivalence of examinations of the previously applicable and the amended curriculum can be found in Appendix 1 (Equivalence Table).

| Master's degree programme Information and Communications Engineering, Version 22W.1, announced in the University Bulletin dated 29.06.2022, Special Issue 21, No. 101.4   |             |              | Master's degree programme Information and Communications Engineering, Version 15W, announced in the University Bulletin dated 02.05.2015, Issue 16, No. 117.6 |             |              |
|---|-------------|--------------|---|-------------|--------------|
| Course  | Course type | ECTS credits | Course  | Course type | ECTS credits |
| 1.1 Mobile Communications   | VC          | 4            | Mobile Communications   | VK          | 4            |
| 1.1 Signal Processing for Communications  | VC          | 4            | Signal Processing for Communications  | VK          | 4            |
| 1.1 Sensor Networks   | VC          | 4            | Sensor Networks   | VK          | 4            |
| 2.1 Robotics Fundamentals   | VC          | 4            | Robotics  | VK          | 4            |
| 2.1 Sensors and Actuators   | VC          | 4            | Sensors and Actuators   | VK          | 4            |
| 2.1 Control of Autonomous Systems   | VC          | 4            | Control of Autonomous Systems   | VK          | 4            |
| 3.1 Value based Management  | VC          | 2            | Value based Management  | VK          | 2            |
| 3.1 Operations Management and Logistics   | VC          | 2            | Operations Management and Logistics   | VK          | 2            |
| Privatissimum accompanying the Master's thesis  | PV          | 3            | Privatissimum accompanying the Master's thesis  | PV          | 6            |
| Guided electives: Successfully completed courses from the guided electives according to § 9 of the Master's degree programme in Information and Communications Engineering (version 15W, prior to 01.10.2022) shall be fully recognised in lieu of the respective guided elective of the Master's degree programme in Information and Communications Engineering (version 22W.1). |             |              |   |             |              |

## APPENDIX 2 Non-Binding Recommended Course of Study

*Branch of study Networks and Communications, non-binding recommended course of study*

| Designation                               | 1 <sup>st</sup> semester | 2 <sup>nd</sup> semester* | 3 <sup>rd</sup> semester* | 4 <sup>th</sup> semester | ECTS credits      |
|---|--------------------------|---------------------------|---------------------------|--------------------------|-------------------|
| Networks and Communications: Fundamentals | 8                        | 4                         |                           |                          | 12                |
| Networks and Communications: Advanced     | 22                       | 8                         |                           |                          | 30                |
| ICE-Supplements                           |                          | 18                        |                           |                          | 18                |
| Technical Complements                     |                          |                           | 12                        |                          | 12                |
| Soft Skills                               |                          |                           | 12                        |                          | 12                |
| Open Electives                            |                          |                           | 6                         |                          | 6                 |
| Master's Thesis incl. Supervision         |                          |                           |                           | 27                       | 27                |
| Final Board Examination                   |                          |                           |                           | 3                        | 3                 |
| <b>ECTS credits</b>                       | <b>30</b>                | <b>30</b>                 | <b>30</b>                 | <b>30</b>                | <b>Total: 120</b> |

\* Recommended mobility window

*Branch of study Autonomous Systems and Robotics, non-binding recommended course of study*

| Designation                                   | 1 <sup>st</sup> semester | 2 <sup>nd</sup> semester* | 3 <sup>rd</sup> semester* | 4 <sup>th</sup> semester | ECTS credits      |
|---|--------------------------|---------------------------|---------------------------|--------------------------|-------------------|
| Autonomous Systems and Robotics: Fundamentals | 4                        | 8                         |                           |                          | 12                |
| Autonomous Systems and Robotics: Advanced     | 26                       | 4                         |                           |                          | 30                |
| ICE-Supplements                               |                          | 18                        |                           |                          | 18                |
| Technical Complements                         |                          |                           | 12                        |                          | 12                |
| Soft Skills                                   |                          |                           | 12                        |                          | 12                |
| Open Electives                                |                          |                           | 6                         |                          | 6                 |
| Master's Thesis incl. Supervision             |                          |                           |                           | 27                       | 27                |
| Final Board Examination                       |                          |                           |                           | 3                        | 3                 |
| <b>ECTS credits</b>                           | <b>30</b>                | <b>30</b>                 | <b>30</b>                 | <b>30</b>                | <b>Total: 120</b> |

\* Recommended mobility window



*Branch of study Business and Engineering, non-binding recommended course of study*

| Designation   | 1 <sup>st</sup> semester | 2 <sup>nd</sup> semester* | 3 <sup>rd</sup> semester* | 4 <sup>th</sup> semester | ECTS credits      |
|---|--------------------------|---------------------------|---------------------------|--------------------------|-------------------|
| Management and Economics: Fundamentals                            | 4                        | 4                         |                           |                          | 8                 |
| Management and Economics: Advanced                                | (4)/12                   | 12                        | (8)/0                     |                          | 24                |
| Management and Law: Complements                                   |                          |                           | 8/(0)                     |                          | 8                 |
| <b>or</b>   |                          |                           |                           |                          |                   |
| Management and Economics: Basic Courses                           | (8)/0                    |                           |                           |                          |                   |
| Networks and Communications resp. Autonomous Systems and Robotics | 14                       | 14                        | 10                        |                          | 38                |
| Soft Skills   |                          |                           | 6                         |                          | 6                 |
| Open Electives  |                          |                           | 6                         |                          | 6                 |
| Master's Thesis incl. Supervision                                 |                          |                           |                           | 27                       | 27                |
| Final Board Examination   |                          |                           |                           | 3                        | 3                 |
| <b>ECTS credits</b>   | <b>30</b>                | <b>30</b>                 | <b>30</b>                 | <b>30</b>                | <b>Total: 120</b> |

\* Recommended mobility window