ORIGINAL TEXT - FULL TEXT

Approved by order No 179 of 14 October 2024 of the Vice-Rector for Academic Affairs

In force from: 01.01.2025

Establishment of the Requirements and Procedure for Developing Transversal and Discipline-Specific Competencies

Based on clause 3 (5) 1) of the Study Programme Statute established by Regulation No 4 of 7 October 2014 of the Senate of Tallinn University of Technology,

1. To ensure a consistent level of proficiency of the graduates of Tallinn University of Technology (hereinafter also referred to as "TalTech") and to support the acquisition of future-proof competencies[1], I have established mandatory transversal[2] and discipline-specific competencies[3] to be incorporated into Bachelor's, professional higher education, and integrated Bachelor's and master's study programmes.

2. Transversal competencies (Annex 1) are self-management and learning, critical thinking, collaboration, communication and ethics competencies.

3. Transversal competencies are integrated into the teaching of compulsory courses, i.e. they are incorporated into the learning outcomes and assessment of selected courses. Transversal competencies may be incorporated into elective courses, provided the structure of the study programme modules ensures that every learner acquires all the competencies established by the order.

4. The inclusion of courses covering transversal competencies in a study programme is verified by the Office of Academic Affairs both when the study programme is launched and during the internal evaluation of study programmes.

5. The Vice-Rector for Academic Affairs has the right to convene a committee, comprising representatives from all Schools, to update the content of transversal competencies and propose necessary revisions.

6. The discipline-specific competencies, the minimum workload required for teaching the competencies, and the Schools responsible for their development and assessment are as follows:

Discipline-specific competencies	Minimum workload (ECTS credits)	Responsible School
Digital competence (Annex 2)	6	School of Information Technologies
Entrepreneurship competence (Annex 3)	3	School of Business and Governance
Sustainable development competence (Annex 4)	3	School of Engineering
Mathematics competence (Annex 5)	6	School of Science
Engineering competence (Annex 6)	3	School of Engineering

[1] A competency is the ability to purposefully and effectively apply knowledge, attitudes, values, and skills to address specific situations in life. Competencies that promote the development of future-proof skills can be categorised into discipline-specific competencies, transversal competencies, and professional competencies.

[2] Transversal competencies are cross-disciplinary and cross-course competencies that help persons adapt in diverse areas of life.

[3] Discipline-specific competencies are the knowledge, skills, and attitudes within a particular field, enabling learners to engage effectively in activities and pursue further learning within that discipline. At TalTech, the discipline-specific competencies are taught to ensure a consistent level of proficiency of all students, regardless of their specialization.

7. The School responsible for teaching a discipline-specific competency must develop at least one course with a minimum workload covering all the learning outcomes associated with the relevant competency.

8. A course covering discipline-specific competencies may be replaced in the study programme by one or more other courses, as long as they include the learning outcomes associated with the corresponding competency.

9. To approve the replacement of a course covering discipline-specific competencies, the Vice-Rector for Academic Affairs shall establish a committee of discipline-specific competencies, appoint its head and approve its rules of procedure. The committee shall include one representative from each School.

10. To replace a course covering discipline-specific competencies, the programme director shall submit his/her proposals to the head of the committee.

11. The head of the committee decides whether to approve the course(s) proposed by the programme director or to convene the committee of discipline-specific competencies.

11.1 A course covering discipline-specific competencies is approved if the learning outcomes of the planned course(s) align with those associated with the competency, and the content corresponds to the description of the competency. If a course is not approved, a rationale shall be provided along with recommendations for improvement.

11.2 The programme director may appeal the decision of the head of the committee within 14 days of its receipt requesting the Office of Academic Affairs to convene the committee of discipline-specific competencies to review the evaluation.

12. The committee of discipline-specific competencies has the right to make proposals to the Vice-Rector for Academic Affairs regarding revision of the competencies.

13. I have established additional requirements for Mathematics (Annex 7) and Physics (Annex 8) courses in the following study programme groups, and designated the School responsible for their development and assessment:

Additional requirements	**Study programme group:**	**Responsible School**
Mathematics (Annex 7)	Physical Sciences; Business and Administration; Transport Services; Architecture and Building; Engineering, Manufacturing and Technology; Informatics and Information Technology.	School of Science
Physics (Annex 8)	Architecture and Building; Engineering, Manufacturing and Technology; Physical Sciences; Informatics and information Technology.	School of Science

14. The School responsible for the additional requirements shall develop an adequate number of courses based on the learning outcomes outlined in the additional requirements and the needs of the specialities to be included in the study programme groups specified in clause 13.

15. The School responsible for the additional requirements has the right to make proposals to the Vice-Rector for Academic Affairs to revise their content.

16. The order shall enter into force on 1 January 2025.

17. The Schools are required to review all the study programmes open for admission and ensure they are updated in accordance with the requirements of this order and the Study Programme Statute by the academic year 2028/2029, with the exception of the task outlined in clause 7, which must be completed by 1 May 2025.

18. I hereby repeal order No 80 of 20 May 2016 of the Vice-Rector for Academic Affairs “Establishment of the Subject Area Requirements in the Study Programmes of the First and Second Level of Higher

Education", with the provision that the discipline-specific competencies specified in the order shall continue to be part of the study programmes during the transitional period until they are replaced.

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Annex 1

1. Transversal competencies

1.1 Self-management and learning

Learning outcome: A TalTech graduate sets goals, plans and analyses his/her actions and adapts effectively to change.

Sub-competencies:

- self-directed learning
- self-regulation
- learning skills

A self-directed person independently sets tasks, manages his/her time effectively, and acts with consistency to achieve his/her goals, adapts to changing circumstances when needed, handles setbacks with resilience, and takes full responsibility for the consequences of his/her actions. Self-management relies on self-regulation, the ability to evaluate and adjust one's behaviour, thoughts, and emotions effectively in various situations, and through this ensures both mental and physical well-being. A learning skill is the ability to seek out relevant information and guidance, utilise various learning strategies to connect new knowledge with previous learning, and apply existing knowledge in diverse contexts. Learning skills are enhanced by the growth mindset, i.e. a belief that skills and abilities can be learned and improved.

1.2 Critical thinking

Learning outcome: A TalTech graduate critically evaluates the evidence behind the information required to solve problems.

Sub-competencies:

- critical information gathering
- analytical skills
- problem-solving skills
- argumentation skills
- self-evaluation skills

At its core, critical thinking means forming judgements through a systematic process of reasoning. This involves the ability to use reason to evaluate the information collected, i.e. to assess the credibility and reliability of sources, identify biases, analyse the relevance of content, distinguish between various types of information, such as facts, theories, opinions, descriptions, persuasions. The ability to systemically analyse information, identify key aspects, and draw conclusions is essential. This skill primarily involves identifying problems and determining their root causes, as well as applying the scientific method, where hypotheses are developed and tested through observations and measurements. Critical thinking enables you to provide multiple solutions to problems and evaluate their strengths and weaknesses. Problem-solving relies on a step-by-step approach: breaking the problem down into more manageable parts, developing a step-by-step solution, and evaluating both the process and the outcome, including synthesis. It also involves the ability to analyse stakeholders' perspectives and assess the broader implications of applying different solutions. A key aspect of critical thinking is to evaluate others' arguments, identify logical flaws, and recognize demagogic tactics. To present your views convincingly, you must effectively construct your own arguments. An essential aspect of critical thinking is being aware of one's own knowledge, skills, and attitudes, which includes recognising the boundaries of personal expertise and relying on specialists in other areas.

1.3 Collaboration

Learning outcome: A TalTech graduate actively contributes to setting shared objectives and developing effective solutions to challenges.

Sub-competencies:

- emotional intelligence
- setting common goals
- defining team roles
- taking responsibility

The ability to collaborate is rooted in socio-emotional competencies. Collaborating with others involves managing your own emotions and accepting and responding appropriately to other people's strong feelings. Collaboration should be demonstrated within interdisciplinary and multicultural. Successful collaboration is built on common goals that align with the personal needs and objectives of the team members, so that each member can contribute to achieving the team's goals. It is essential to assess your own strengths and weaknesses, as well as those of one´s teammates, and assign or assume the appropriate roles based on the assessment. It is important to understand one's own role, interactions with others, and the responsibilities it entails, while also valuing the contributions of all team members. When needed, one must stay focused to effectively contribute to achieving the goal. Successful collaboration is fostered by clear communication and use of suitable collaboration methods (incl. virtual ones).

1.4 Communication

Learning outcome: A TalTech graduate expresses himself/herself clearly, politely and appropriately, adapting his/her communication style to suit both the audience and the situation.

Sub-competencies:

- self-expression in various forms
- adapting communication styles
- providing feedback

Communication skills refer to the ability to convey information clearly, appropriately and politely, whether through verbal, written, or visual channels. A person with good communication skills understands his communication partners and adapts his/her behaviour to suit the situation. To achieve this, one must be able to listen actively to fully understand the speaker's message. The foundation for building a common understanding lies in the courage and ability to ask relevant questions. Communication skills include giving and receiving constructive feedback.

1.5 Ethics

Learning outcome: A TalTech graduate upholds ethical standards in his/her professional activities and is a responsible member of society.

Sub-competencies:

- discipline-specific ethics
- social responsibility

Ethics refers to the moral principles and values that guide people in making decisions and shaping their behaviour. This means that alongside professional competence, it is also important to be an ethically aware and responsible member of society. Ethics involves understanding the principles of ethical decision-making and applying them to analyse and evaluate the moral implications of one's choices. It is essential to be aware of the ethical dilemmas within one's field, to address them effectively, and to understand the ethical implications of professional decisions and their social impact. Furthermore, it is important to analyse the expression of values and attitudes in society, recognise one's role in society, and actively contribute to the well-being of the community.

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Annex 2

2. Digital competencies

Sub-competencies:

- content creation competencies
- digital data processing
- algorithmic thinking
- deployment of cybersecurity measures
- knowledge of artificial intelligence

Digital competencies mean the ability to use digital environments and tools purposefully and safely, and the ability to create, evaluate and protect digital content. Digital competencies encompass the ability to use digital technologies and platforms for collaboration. It involves the ability to search for data, analyse it, and assess its reliability by extracting the most relevant information from large volumes of data. One must be able to manage and process data. To create and adapt digital content, it is essential to understand the capabilities of available digital tools and the limitations associated with intellectual property rights. It is also important to understand the fundamentals of cybersecurity, particularly the methods for protecting digital devices, personal data, and privacy. Digital competencies involve responsible use of digital technologies, as well as the ability to manage and resolve cyber incidents and crises. Moreover, they involve the ability to use artificial intelligence efficiently and ethically.

Goal

Digital competencies enable you to use ICT tools to create, present, and interpret information, as well as to solve work-related problems creatively, efficiently, and effectively. A digitally competent person understands the value and potential applications of data and is aware of the opportunities, risks, and limitations associated with using IT in a networked world. It is essential to cultivate critical and analytical thinking and foster a responsible approach to the safe and ethical use of information technology.

Learning outcomes for acquiring the competencies in **professional higher education, bachelor's and integrated Bachelor's and master's study programmes:**

1. Uses relevant software to collaborate in teamwork and create texts, tables, graphs, and presentations, while adhering to copyright principles in content creation.
2. Processes data digitally.
3. Applies the principles of algorithmic thinking to analyse the complete process and proposes software solutions to address the problems set.
4. Adheres to cybersecurity principles to mitigate cyber threats while upholding ethical standards.
5. Is aware of the main types of artificial intelligence, their capabilities, limitations, and broader implications.

The **minimum workload required to cover the learning outcomes is 6 ECTS credits** (i.e. 1 ECTS credit for each learning outcome).

A more detailed explanation of the learning outcomes

1. Uses relevant software to collaborate in teamwork and create texts, tables, graphs, presentations, while adhering to copyright principles in content creation.

   The learning outcome involves selecting appropriate software and applying it to solve a variety of content creation tasks. These tasks include drafting and formatting text, presentations, graphs, tables

and documents. Furthermore, TalTech graduates adapt to the teamwork software used in their work environment and adhere to copyright protection principles in their work.

2. Processes data digitally.

   Digital data processing encompasses the ability to collect, securely store, organise, prepare, analyse, visualise, and share data using spreadsheets, programming tools, or other software. It is important to develop the ability to interpret data, identify errors, and draw conclusions from them. To avoid digital waste, it is essential to understand when data collection is unnecessary and to know when to delete redundant data.

3. Applies the principles of algorithmic thinking to analyse the complete process and propose software solutions to address specific problems.

   Algorithmic thinking helps to break down problems and systems of varying complexity into smaller parts, enabling the identification of patterns and similarities within these sub-parts. To distinguish between essential and irrelevant information is also important. Based on the process analysis, a process flowchart can be created to map the relationships between the sub-parts, or calculation rules can be developed to provide a comprehensive overview. This allows for the creation of a use case example and the development of a software solution, either independently or in partnership with a software developer.

4. Adheres to cybersecurity principles to mitigate cyber threats while upholding ethical standards.

   Understanding cybersecurity principles means being aware of the threats (including cyber fraud) and risks associated with using devices, networks, and applications, as well as processing and sharing data. It also involves protecting oneself from these threats by implementing effective security strategies. A digitally competent user understands the principles of data confidentiality, integrity, availability, and backup, as well as the secure handling of data generated during professional activities, and consistently applies this knowledge in daily practice. A university graduate shares information securely online and safeguards both their own and others' privacy and dignity in cyberspace. Digital competencies in cybersecurity encompass knowledge of verification and digital signing principles, the role of security certificates, cryptography, and two-step verification, as well as the application of data protection principles in one’s activities.

5. Is aware of the main types of artificial intelligence, their capabilities, limitations, and broader implications.

   Knowledge of the different fields and types of artificial intelligence enables the assessment of their capabilities, limitations, and costs, both in terms of data processing, information search, and problem solving, while also considering their broader social impact. Above all, it is crucial to understand the potential of machine learning methods and large language models (LLMs), as well as to stay informed about the latest advancements in artificial intelligence. Along with the use of AI, it is essential to consider the ethical implications of its implementation, including issues of bias, the risks associated with AI-driven decisions, and the possibilities to address these challenges.

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Annex 3

3. Entrepreneurship competencies

Sub-competencies:

- understanding the economic environment
- understanding the business process
- value creation thinking

Entrepreneurial competencies are defined as a comprehensive combination of knowledge, abilities, and attitudes required to create value through idea implementation, promote personal entrepreneurship, and achieve sustainable success in both professional and daily life. Entrepreneurship competencies offer a deep understanding of entrepreneurship as a phenomenon, enabling individuals to adopt an entrepreneurial mindset in various roles and view entrepreneurship as a career opportunity.

Goal

Entrepreneurship competencies foster personal and professional growth and contribute to economic and social development.

Learning outcomes for acquiring the competencies in **professional higher education, bachelor's and integrated Bachelor's and master's study programmes:**

1. Navigates the business ecosystem with ease.
2. Applies knowledge of business processes in his/her work within the organisation.
3. Collaborates with representatives from other disciplines to plan business ideas.

A more detailed explanation of the learning outcomes

1. Navigates the business ecosystem with ease.

   Understanding entrepreneurship requires a general knowledge of economics to identify opportunities in any business activity. Identifying business opportunities relies on the ability to navigate the business environment and analyse its influence on value-creating activities. It helps to understand the characteristics of a company's field of activity and the broader macro environment, both when launching a new business and when making strategic adjustments to the future operations of an established company. Understanding the business environment entails the ability to monitor and analyse changes in the economic landscape (such as global economic cycles, growth, recessions, exchange rates, capital markets, interest rates, world market prices, and inflation) along with changes in the political, social, technological, and ecological environments at local, national, and global levels. The multi-level perspective, encompassing micro-, meso-, and macro-level determinants, has become essential for analysing processes in the context of the green transition.

2. Applies knowledge of business processes in his/her work within the organisation.

   An organisation is a structured and organised group of individuals formed to achieve a common goal. There are different types of organisations categorised by age, size and function (public, private or third sector). To understand how an organisation works, it is important to understand the organisation's objectives, resources, work processes, collaboration models and ability to adapt to changes. Business organisations or enterprises are one of the most significant actors in entrepreneurial ecosystems. Working in a business organisation requires a clear understanding of its business model, i.e. how the company creates, delivers, and captures value for its stakeholders. Financial literacy is also important, as it encompasses the skills needed to mobilise resources and effectively manage the financing of value-creating activities over the long term. One of the key aspects of conscious entrepreneurship is

understanding the (personal) characteristics of an entrepreneurial leader, as well as recognising the critical role of management and leadership in planning and designing the work environment, processes, resources, and other elements that support the organisation's goals. This is further enhanced by the ability to apply project management principles to achieve specific, short-term goals within a defined timeframe and scope.

3. Collaborates with representatives from other disciplines to plan business ideas.

   One of the key entrepreneurship competencies is the ability to develop and refine concepts, including business concepts. This requires a systemic perspective (the ability to see the big picture) on entrepreneurship, innovation, and change management in society, considering the global megatrends and technological development. When developing concepts, it is essential to adopt a value-based approach. This means identifying problems and seeking solutions by applying the principles of creativity, ethics, sustainability, and (social) responsibility. Innovation often entails a novel combination of new and existing knowledge, technologies, resources, and practices. In the context of entrepreneurship, creativity is a process that involves combining various types of information into a novel and contextually functional whole. It is difficult to provide innovative solutions when you have only experienced a narrow range of perspectives. Therefore, innovation requires teamwork, close communication, coordination, and collaboration among team members, across disciplines, and between various stakeholders within the innovation system, across sectors (public, private, and third sector) and borders (local, national, and global).

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Annex 4

4. Sustainable development competencies

Sub-competencies:

- awareness of environmental problems
- sustainable management competencies
- environmental impact assessment skills
- implementation of sustainability principles

The transversal competencies in sustainable development encompass awareness of both global and local environmental issues and resource efficiency and involve integrating thereof into one's professional practices. A prerequisite for sustainable management and resource use is an understanding of environmental impacts, along with the ability to assess and analyse these impacts. Implementing transversal competencies in sustainable development requires systemic thinking. In professional activities, it is important to find solutions that prevent the further deterioration of environmental problems.

Goal

Today, it is essential to comprehend global social and environmental challenges and to be able to mitigate them. It is becoming increasingly important to offer solutions in professional practice that prevent environmental problems from deteriorating, promote more efficient resource use, and support smarter environmental management to create a sustainable living environment for future generations. Sustainable development competencies enhance competitiveness in the labour market.

Learning outcomes for acquiring the competencies in **professional higher education, bachelor's and integrated Bachelor's and master's study programmes:**

1. Considers global environmental issues in his/her professional activities.
2. Knows the principles of sustainable economy.
3. Describes various methods for assessing environmental impacts and makes more sustainable choices when selecting products, services, materials and processes.
4. Systemically addresses sustainability challenges within specific sectors.

The minimum workload to cover the learning outcomes is 3 ECTS credits, or their continuous development in various courses throughout the study.

A more detailed explanation of the learning outcomes

1. Considers global environmental issues in his/her professional activities.

   The learning outcomes are built on an awareness of diverse global environmental issues. One aspect of the outcome is to describe the impacts of human activities on the environment and explain the resulting changes. This also encompasses an awareness of the importance of environmental protection, including the conservation of biodiversity. A TalTech graduate considers the environmental impacts of his/her professional activities. At the bachelor's level, this does not necessarily mean the ability to mitigate environmental impacts, but it involves an awareness of their potential consequences.

2. Knows the principles of sustainable economy.

   Economy is evolving, with a growing emphasis on sustainable economic models such as circular economy, degrowth, and social entrepreneurship, rather than the classical model. A TalTech graduate

is aware of various economic models and can explain their differences. A TalTech graduate assesses how well his/her own or a company's business model aligns with sustainable management practices.

3. Describes various methods for assessing environmental impacts and make more sustainable choices when selecting products, services, materials and processes.

   The important tools for sustainable development include various environmental impact assessment methods, such as life cycle analysis and carbon footprint calculations, which are used to evaluate the environmental impacts of products, services, and processes. A TalTech graduate is familiar with various environmental impact assessment methods and can explain their underlying principles. Graduates of bachelor's programmes compare or provide a rough order of magnitude estimate of the environmental impacts of products, services, and processes.

4. Systemically addresses sustainability challenges within specific sectors.

   The implementation of sustainable development principles relies on a systemic approach to sectoral challenges, which acknowledges the combined impact of environmental, social, economic, and engineering factors. It is essential to recognise the connections between these sectors as part of the wider perspective of the functioning of the society. This requires an understanding of the sustainability aspects of sectors with significant environmental impact, such as construction, energy, transportation, industry, and agriculture.

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Annex 5

5. Mathematical competencies

Sub-competencies:

- functional mathematical literacy
- mathematical modelling
- using analytical and numerical methods
- verifying the steps of solutions

Mathematical competencies mean the ability to apply and develop mathematical reasoning. The essential knowledge in mathematics encompasses a solid understanding of numbers, fundamental mathematical operations, key mathematical terms and concepts, and an awareness of the problems that mathematics can help solve. A student gains the competencies to apply fundamental knowledge, mathematical principles, and processes and to follow and assess chains of reasoning. A TalTech graduate can think mathematically, understanding mathematical proofs, communicating using mathematical language, and utilising appropriate tools and resources.

Goal

Mathematical competencies are required to solve problems in professional life and to adapt to a constantly changing world. Mathematics fosters analytical and algorithmic thinking, establishing logical connections, systematic problem-solving skills and enhances critical thinking.

Learning outcomes for acquiring the competencies in **professional higher education, bachelor's and integrated Bachelor's and master's study programmes:**

1. Demonstrates functional mathematical literacy.
2. Develops mathematical models and draws conclusions based on the models.
3. Applies appropriate methods to solve mathematical problems within his/her field.
4. Verifies answers and the steps of solutions to discipline-specific mathematical problems using various tools.

A more detailed explanation of the learning outcomes

1. Demonstrates functional mathematical literacy.

   Mathematical literacy encompasses the ability to use of mathematical symbols, the understanding of texts containing such symbols, the ability to think mathematically, i.e. to construct valid statements and logical argumentation, and application of higher mathematics to support and prove one's statements. These competencies include an understanding of and the ability to apply mathematical logic, construct proofs or transformations, transform mathematical expressions and comprehend mathematical statements and reasoning presented by others. Mathematical competencies also include the ability to formulate hypotheses and test or disprove them using higher mathematics.

2. Develops mathematical models and draws conclusions based on the models.

   This learning outcome encompasses the ability to translate a problem in the field into mathematical language, expressing it in numbers and mathematical relationships, i.e. to select the appropriate fields of mathematics (such as algebra, analysis, geometry, probability theory, statistics, etc.) for model development, validation, simplification and result analysis. A graduate may not be able to solve a complex mathematical problem independently, but he/she must be able to understand and analyse others' solutions, and justify their decisions based on the interpretation of models.

3. Applies appropriate methods to solve mathematical problems within his/her field.

   A graduate solves mathematical problems within his/her field, select suitable solution methods, and understands the difference between numerical and analytical approaches. A graduate is familiar with the numerical methods used in the field and can select appropriate methods in accordance with the task or requirements. It also includes knowledge of the operating principles of specialised software, including the limitations of the underlying models.

4. Verifies answers and solutions to discipline-specific mathematical problems using various tools.

   A key aspect of mathematical competencies is a critical mindset toward evaluating one's own or others' solutions. It is essential to verify the consistency of results by comparing them using various approximation methods and theory, as well as to identify any discrepancies between the results and initial expectations. Approximations and simplifications can be used to verify whether the rough order of magnitude estimate, or the behaviour of the result aligns with expectations.

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Annex 6

6. Engineering competencies

Sub-competencies:

- future trends in the built environment
- engineering regulations and standards
- uncertainties and contingency factors in the design of the built environment

Engineering competencies encompass the knowledge and understanding of megatrends and emerging developments in engineering and technology, the engineering profession and regulations in the field, as well as the ability to make data-driven decisions based on observations and measurements.

Goal

Engineering competencies enhance the understanding of the technological and technical aspects of a field, enabling more effective integration of technology into work. Moreover, engineering competencies promote critical thinking, help to associate laws of nature with built environments and enable individuals to solve problems both systemically and creatively, whether they involve specific field-related issues or broader technical challenges. Engineering competencies help graduates to be better prepared for working in interdisciplinary work environments.

Learning outcomes for acquiring the competencies in **professional higher education, bachelor's and integrated Bachelor's and master's study programmes:**

1. Associates emerging trends in the built environment and technological development with his/her field.
2. Understands the importance of regulations in engineering and the design of the built environment.
3. Considers uncertainty and contingency factors when making data-driven decisions and analysing the built environment.

A more detailed explanation of the learning outcomes

1. Associates emerging trends in the built environment and technological development with his/her field.

To navigate the evolving world and the field of technology, it is important to be familiar with the most relevant engineering disciplines and have an understanding of their interconnections. This entails the ability to analyse and evaluate changes in the built environment (buildings, infrastructure, vital technology-based products and services, and communication systems) while considering natural laws, future trends in various fields, incl. their relationship with sustainable development, and their broader impact on society.

2. Understands the importance of regulations in engineering and the design of the built environment.

Working in engineering fields (such as construction, energy, and mechanics) is primarily governed by occupational qualification standards that outline the competencies and responsibilities required for designing and managing the built environment. At the same time, an engineer must consider international guidelines and emerging trends (such as the EU's green transition and sector-specific development strategies, etc.) in his/her work. Therefore, it is crucial to understand the impact of strategic development plans and standardized work environments on our decisions and cross-disciplinary collaboration.

Moreover, to ensure the continuous operation and functionality of buildings, facilities, and infrastructure, a wide range of design standards have been established to guarantee the safety and reliability of systems. It is essential to understand how established guidelines limit and/or foster creativity and cross-disciplinary collaboration.

3. Considers uncertainty and contingency factors when making data-driven decisions and analysing the built environment.

Data-driven decision-making requires high-quality data. For this, you must know how to gather data through observations, monitoring, on-site measurements, and other methods, evaluate previously collected data, verify its accuracy and quality, and analyse simpler current processes in the engineering field using this data. In addition, it is important to understand how to account for uncertainty in various areas, including monitoring and observations, and know when and how to incorporate contingency factors to ensure the safety of the built environment.

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Annex 7

7. Additional requirements for mathematics

Additional requirements for mathematics are recommended for the following study programme groups:

- Physical sciences;
- Business and administration;
- Transport services;
- Architecture and building;
- Engineering, manufacturing and technology:
- Informatics and information technology.

Goal

The goal of the additional requirements is to provide fundamental knowledge of the probability theory, linear algebra, and mathematical analysis. The aim is to teach to solve tasks related to the abovementioned fields.

Learning outcomes

1. Knows the key terms used in matrix and vector algebra, understands the systems of linear equations and solves standard problems relevant to the field; understands the key concepts and methods related to the field and knows how to apply them.
2. Knows the key terms of differential and integral calculus for functions of one variable or multiple variables, including their properties and basic applications; and differentiates functions and calculating simpler integrals.
3. Understands the power series required to solve field-specific problems and knows how to apply them.
4. Knows the key terms of probability theory and mathematical statistics, calculates point and range estimates, and is familiar with various distribution functions.
5. Is familiar with mathematical modelling software and applies it to solve field-related tasks.

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Annex 8

8. Additional requirements for physics

Additional requirements for physics are recommended for the following study programme groups:

- Architecture and building;
- Engineering, manufacturing and technology:
- Physical sciences;
- Informatics and information technology;

Goal

The goal of the additional requirements is to develop students' ability to search for, assess, and apply relevant physics information in their professional practice; to provide students with an overview of the relevant key branches of physics and establish the foundation for applying this fundamental knowledge in analysing problems related to their field.

Learning outcomes

1. Knows the fundamentals of conducting physical experiments and evaluates experiment results and uncertainty of measurement.
2. Applies physical quantities, units, vector algebra, and differential and integral calculus to analyse and solve problems in mechanics, thermodynamics, electromagnetism, and optics, as required within his/her field.
3. Applies the principles of mechanics, thermodynamics, electromagnetism, and optics to describe and analyse engineering problems within his/her field, as well as phenomena in the surrounding living environment.