Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Basic module Advanced Manufacturing

Module number	220000-614 (Version 02)
Module name	Mathematics for Engineering Science
Module responsibility	Dean of Studies for all study programs of the Faculty of Mathematics (except the study programs- Data Science, MINT, Advanced and Computational Mathematics)
Content and module objectives	Contents: The module focuses on the following topics: • Linear algebra (linear mappings, systems of equations, eigenvalues) • Power series, Taylor series and Fourier series • Differential and integral calculus (one- and multidimensional) • Ordinary differential equations • Laplace and Fourier Transformation Module objectives: The goal of the module is to achieve a uniform level of practically applicable knowledge of mathematics. This requires an understanding of terms, structures and methods. Students are put in a position to do so, to translate engineering science questions into mathematical language and to solve them. The qualification goal of the internship is the acquisition of methods and procedures for the independent application of mathematical concepts and methods.
Teaching formats	Lectures (L), exercises(Ü) and practical courses(P) are the teaching forms of the module • L: Mathematics for Engineering Science (2 LVS) • Ü: Mathematics for Engineering Science (1 LVS) • P: Mathematics for Engineering Science (1 LVS) The teaching events will be held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
	The fulfillment of the admission requirements for the examination performance and the successful completion of the module examination are requirements for the award of credit points. Admission requirement is the following preliminary examination (can be repeated indefinitely): • Processing of 5 task complexes for the practical course Mathematics for Engineering Science, which must be passed individually. Passed means that at least 50% of the evaluation points have been achieved. The preliminary exam must be taken in English.
Module exam	There is one examination: • 120-minute exam about the Mathematics for Engineering Science (Exam number: 20096) The exam is conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Basic module Advanced Manufacturing

Modul number	231533-029 (Version 01)
Modul name	Digital Tools for Smart Manufacturing
Module responsibility	Professorship of Production Systems and Processes
Content and module objectives	Contents: Modern industrial production is characterized by the intensive use of information and communication technology. The basis for this are intelligent and digitally connected systems. The module provides basic knowledge of digital tools for the efficient design and optimisation of joining, forming, ablation and additive manufacturing processes as well as for the creation of geometric product specifications. A special focus is on extended reality technologies and their use in production technology, on the creation and use of digital twins and the concept of virtual commissioning. Module objectives: After successful completion of the module, students will be able to: • Explain the concept of the digital twin and describe data management systems and platforms from product data management (PDM) to product lifecycle management (PLM) and the Industrial Metaverse, • Reproduce basic terminology for extending 3D CAD models with Product Manufacturing Information (PMI), process data for joining processes, digital tools for additive manufacturing, nonlinear FEM simulation for forming processes, and modelling methods for ablation processes, • Describe the basics, applications and challenges of Extended Reality (XR) and create corresponding applications and • To be able to apply XR in medical technology as well as for virtual commissioning.
Teaching formats	Teaching formats of this module are lectures (V) and exercise (Ü) • V: Digital Tools for Smart Manufacturing (2 LVS) • Ü: Digital Tools for Smart Manufacturing (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	Die Module has one examination: • 120-minute Exam of Digital Tools for Smart Manufacturing (Exam number: 33645) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Basic module Advanced Manufacturing

Module number	231231-014 (Version 01)
Module name	Humans and Mechatronics in Manufacturing
Module responsibility	Professorship of Ergonomics and Innovation Management
Content and module objectives	Contents: The module provides a fundamental understanding of how humans and technology interact in modern production from the perspectives of ergonomics, factory planning and mechatronics. The focus is on: • Classifications of industrial production and basics of factory planning • Fundamentals of mechatronic systems in production and their interaction with humans • Data acquisition, analysis and application in mechatronic systems • Methods and instruments for the metrological recording of human-technology-environment interactions • Fundamentals of the analysis and design of human work in production • Methods of the human-centred development and evaluation of human-technology systems and interactions. Module objectives: After successful completion, students will be able to name, explain and apply practically the specific terms, concepts, methods and instruments for analysing, planning and designing the interaction of humans and mechatronic systems in modern production.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Humans and Mechatronics in Manufacturing (2 LVS) • Ü: Humans and Mechatronics in Manufacturing (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	Die Module has one examination: • 120-minute Exam of Humans and Mechatronics in Manufacturing. (Exam number: 31226) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Basic module Advanced Manufacturing

Module number	231834-009 (Version 01)
Module name	Applied Materials and Composite Structures
Module responsibility	Professorship of Electron Microscopy and Microstructural Analysis
Content and module objectives	Contents: The module imparts basic knowledge about the structure and properties of materials. This includes the atomic structure, bond types, as well as the general crystal systems and crystal structures of metallic, ceramic and polymeric materials. Based on the microstructure of the materials, including typical crystal construction defects and the amorphous state, the connection between important material properties and their structure or microstructure is established. This includes the teaching of important parameters of materials as well as exemplary methods to determine them. In the second half of the course, the importance of the structure-property relationship of materials will be deepened on the basis of selected examples, in particular also on the basis of composites made of different materials, and thus the bridge between materials and production technology will be built. Module objectives: After successful completion of the module, students will be able to present and apply the knowledge they have acquired on the basic structure, properties and characteristics of materials. They can discuss the fundamental suitability of different materials for specific applications, especially with regard to advanced production technology, and, based on basic considerations, suggest possibilities for optimisation. They are able to suggest suitable material characteristics and provide exemplary guidance on how to determine them.
Teaching formats	Teaching formats of the module are Lectures (V) und Seminar (S) • V: Applied Materials and Composite Structures (2 LVS) • S: Applied Materials and Composite Structures (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Applied Materials and Composite Structures (Exam number: 33403) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Basic module Advanced Manufacturing

Module number	231432-008 (Version 01)
Module name	Modelling and Idealization in Manufacturing Simulation
Module responsibility	Professorship of Applied Mechanics and Dynamics
Content and module objectives	Contents: Contents: Manufacturing processes represent complex multi-physical processes. They are used to manufacture components with defined geometry and properties. The complexity of manufacturing processes is therefore based on the linking of different domains of physics such as mechanics, dynamics and thermodynamics. Simulation tools play an increasingly important role in this. They have become indispensable for the planning and optimisation of manufacturing processes. The first step in a simulation of these processes is modelling and idealization. This first step is considered in this module and divided into four parts. The first part of the module focuses on manufacturing processes such as forming and joining. Practical examples show the consequences regarding the significance of finite element simulations with regard to the choice of models and numerical solutions. In the second part, fundamental phenomena of nonlinear material behaviour as well as the determination of associated model parameters are discussed. The third part deals with the mechanisms of heat transfer such as heat conduction, heat transfer and heat radiation. Analytical and empirical approaches to solutions are taught for standard situations. In the last part of the module, the computer-aided modelling of multi-body systems based on the basic elements rigid body, nonlinear spring and viscous damper is presented. Module objectives: After successful completion of the module, students will be able to independently make and critically reflect on model assumptions against the background of a simulation of manufacturing processes. Furthermore, the students are able to analyse and solve technically relevant heat transfer problems as well as discrete dynamic systems, to classify mechanical material behaviour and to determine model parameters.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Modelling and Idealization in Manufacturing Simulation (2 LVS) • Ü: Modelling and Idealization in Manufacturing Simulation (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Modelling and Idealisation in Manufacturing Simulation (Exam number: 33008) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Lightweight Technologies, Electives/Soft skills

Module number	231032-019 (Version 04)
Module name	Composite-based Technologies
Module responsibility	Professorship of Lightweight Structures / Polymer Technology
Content and module objectives	Contents: Cost-efficient large-scale technologies for the production of hybrid composite components are crucial for the industrial use of lightweight materials. In the lectures of the module, the composite materials are divided and their structure and production are explained. Knowledge of fibres, textile structures and polymer matrices, their production and use in fibre-reinforced plastics, selected according to load and with regard to reinforcement effect, strength behaviour and substance utilisation, is acquired. Efficient technologies for the production of thermoplastic and thermoplastic polymer matrix composite semi-finished products and components are explained and compared. Based on this, the processing of polymer matrix composites in mixed construction methods and in hybrid structures is explained and characterised. With regard to the materials and material combinations employed, the principles of the circular economy are examined, with particular emphasis placed on recycling and sustainability. Numerous practical applications will be demonstrated as examples and the basics of test methods will be taught and discussed. In the exercises, methods for determining material parameters are discussed and micromechanical calculations are explained. Based on this, macro-mechanical theories and formulas are discussed and compared. A thermoset-based textile semi-finished product will be produced and mechanically tested, and the methods of manufacturing textile-reinforced thermoplastic components will be demonstrated and explained in the laboratories. Module objectives: The students have demonstrated a comprehensive knowledge of the design and use of hybrid composite structures, their technologies for production and processing, the resulting component properties including suitable measurement and testing methods. The students are able to apply their acquired specialist knowledge in a focused and targeted manner for the development of high-performance lightweight components.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Composite-based Technologies (2 LVS) • Ü: Composite-based Technologies (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90- minute Exam of Composite-based Technologies (Exam number: 33144) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).

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Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Lightweight Technologies, Electives/Soft skills

Module number	231036-004 (Version 03)
Module name	Technical Textile Processes
Module responsibility	Professorship of Textile Technologies
Content and module objectives	Contents: The module teaches the basics of the processes for the production of textile reinforcement structures for high-performance fibre-plastic composites. The focus is on the various textile thread and surface production processes and their individual potentials for the variation/adjustability of composite properties. The conceptual and physical basics of thread formation from filament and staple fibres are taught and the relationships between fibre parameters, spinnability and properties of the produced thread materials are explained. The thread materials are further processed into textile surfaces in the form of fabrics, braids, knitted fabrics and nonwovens. The technological foundations of these manufacturing processes and the physical requirements for processing the high-performance thread materials are presented and, based on this, the differences between the various processes with regard to the resulting material properties are worked out. This creates the prerequisites for the understanding of process and process parameter-specific effects on yarn, surface and, above all, the resulting composite properties. Module objectives: The student has a basic knowledge of the various thread production processes and the most common surface formation processes. Through knowledge of the textile physics and technological basics, he can evaluate the effects of modifications to the textile materials and processes on the resulting composite properties.
Teaching formats	Teaching format of the module is Lectures (V). • V : Technical Textile Processes (3 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Technical Textile Processes (Exam number: 34004) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Lightweight Technologies, Electives/Soft skills

Module number	231133-013 (Version 01)
Module name	Recycling of Plastics
Module responsibility	Professorship of Plastics Technology
Content and module objectives	Contents: This module provides a basic understanding of the structure, composition and behaviour of plastics, including fibres and composites, which are relevant to recycling issues. In addition to an overview of product forms, their composition and processing methods in plastics engineering, the module covers the recycling concepts of product recycling, material recycling and feedstock recycling, along with the limitations of their application to plastics, plastic-containing composites and composite materials, as well as their thermal recovery, with the aim of linking material, technical and economic aspects. In addition, there is an overview of product life cycles with the aim of closed cycles and an introduction to recycling-friendly product design. The lecture also covers alternative material concepts, comparison with classic technologies in the packaging sector and biomaterials (biopolymers, compostable plastics, natural fibre-reinforced plastics). In addition, there are practical exercises on selected technologies, such as plastic detection and sorting, shredding, compounding and master moulding, as well as testing of the independently produced test specimens made of recyclates. Module objectives: Upon successful completion of the module, students will be able to apply the knowledge they have acquired on the basic structure and composition of plastic products in order to implement them in a recycling-friendly design. The students are able to develop a recycling-friendly design for plastic products and to advise on recycling issues in product development. They can evaluate recycling strategies and the use of alternative materials from an economic point of view.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Recycling of Plastics (2 LVS) • Ü: Recycling of Plastics (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Recycling of Plastics (Exam number: 32119) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Lightweight Technologies, Electives/Soft skills

Module number	231032-018 (Version 05)
Module name	Anisotropic Composites
Module responsibility	Professorship of Lightweight Structures / Polymer Technology
Content and module objectives	Contents: In the first step, the module teaches the elasticity theoretical basics for anisotropic material behaviour of the single layer in order to derive the multilayer theory based on this. The multi-layer composites made of fibre-reinforced materials represent forward-looking lightweight construction solutions, especially in aerospace, vehicle construction and general mechanical engineering. Using classical laminate theory as a mathematical tool, students learn to record the complex stress and deformation behaviour of flat surface structures made of fibre-plastic composites (FRP) as a result of mechanical, thermal and media-related loads. In addition, general and fracture-type-related failure hypotheses are taught, which are used in different design concepts. Module objectives: After successful completion of the module, students will be able to calculate components and structures made of a material with anisotropic material behaviour. As a result, they are able to construct a structural behaviour for multi-layer composites through targeted layer orientation and layer structure in line with the load.
Teaching formats	Teaching formats of the module are Lectures (V) und Seminar (S) • V: Anisotropic Composites (2 LVS) • S: Anisotropic Composites (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	General fundamentals of mathematics, physics and technical mechanics.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Anisotropic Composites (Exam number: 33147) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Lightweight Technologies, Electives/Soft skills

Module number	231032-020 (Version 03)
Module name	Lightweight Technologies for Bio-based Structures
Module responsibility	Professorship of Lightweight Structures / Polymer Technology
Content and module objectives	Contents: In the first part, the module teaches the basics of bio-based and/or biodegradable plastics: raw material basis, synthesis, processing, properties and applications. In addition, bio-based composites are considered. The second part covers the extraction and properties of natural fibres, the production of natural fibre semi-finished products and compounds, processing into composite components as well as questions of disposal and recycling. Building on this, the third part of the module deals with the processing of bio-based materials by means of extrusion, injection moulding, pressing processes, additive processes and relevant process combinations. A special focus is placed on the specific requirements and special features of these material classes in the respective processing technologies. Practical courses on the processing of bio-based plastics and composites as well as on the exemplary determination of physical and chemical surface properties complement the curriculum. Module objectives: The students are able to reproduce basic knowledge about the structure and processing of bioplastics and bio-composites as well as their resource efficiency and sustainability and classify them in an application-oriented manner.
Teaching formats	Teaching formats of the module are Lecture (V) and Practical work (P). • V: Lightweight Technologies for Bio-based Structures (2 LVS) • P: Lightweight Technologies for Bio-based Structures (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Lightweight Technologies for Bio-based Structures (Exam number: 33146) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Lightweight Technologies, Electives/Soft skills

Module number	231032-025 (Version 01)
Module name	Carbon Fibre Lightweight Technologies
Module responsibility	Professorship of Lightweight Structures / Polymer Technology
Content and module objectives	Contents: The module looks at the complete process chain for the production, processing, application and recycling of carbon fibres. Based on the market situation and various precursor systems (PAN, lignin, etc.), the lecture deals with the physio-chemical conversion processes (stabilisation, carbonisation) as well as surface treatment and impregnation (interface). Based on this, processes for the production of textile semi-finished products as well as near-net-shape and force-flow-oriented manufacturing technologies will be presented. Recycling strategies as well as topics of process monitoring, quality assurance and energetic considerations of the overall process chain round off the theoretical part. In the accompanying exercises, the theoretical basics are deepened and implemented in an application-oriented manner. Methods of mechanical and chemical characterisation as well as process technologies are illustrated by demonstrations and excursions to research institutions (e.g. Carbon Lab Factory) and discussed on the basis of case studies and regulations (from aviation). A critical examination of selected process chains is carried out by computer-aided life cycle assessment (LCA: Life Cycle Assessment) and the analysis of energy flows. Module objectives: Upon successful completion of the module, students will have detailed knowledge of the process-structure-property relationships of high-performance composites with a focus on carbon fibres. They are able to select suitable manufacturing and testing methods for specific applications and to interpret measurement results correctly. In detail, the students have basic knowledge of the consecutive process steps in the production of carbon-fibre-based lightweight components and are able to recognise relationships between fibre and semi-finished product structure as well as associated manufacturing processes and component properties. Against the background of this process chain-material property correlation, students can use it to analyse suitable systems, processes, procedures and technologies in an application-specific manner and to understand the complex relationships in principle. In addition, they have competencies to evaluate process chains from a techno-economic and ecological point of view and to independently create an LCA for fibre composites.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Carbon Fibre Lightweight Technologies (2 LVS) • Ü: Carbon Fibre Lightweight Technologies (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	The module requires basic knowledge of fibre-plastic composites and their characteristic features.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Carbon Fibre Lightweight Technologies (Exam number: 33137) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.

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Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Smart Manufacturing, Electives/Soft skills

Module number	231732-011 (Version 03)
Module name	Joining Technologies and Strategies
Module responsibility	Professorship of Welding Engineering
Content and module objectives	Contents: The module provides in-depth knowledge of joining techniques used in industry and their possible applications. Joining technologies that are force-, form- and material-fitted, material technology and design aspects of joining processes as well as possibilities for characterising joining properties are covered. Module objectives: The students are able to select joining techniques for different application scenarios, taking into account technological, material engineering and design aspects.
Teaching formats	Teaching formats of the module are Lectures (V), Exercise (Ü) and Seminar (S). • V: Joining Technologies and Strategies (2 LVS) • Ü: Joining Technologies and Strategies (1 LVS) • S: Joining Technologies and Strategies (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 20-minute oral exam of Joining Technologies and Strategies (Exam number: 32715) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Smart Manufacturing, Electives/Soft skills

Module number	231537-003 (Version 03)
Module name	Forming Process Chains
Module responsibility	Professorship of Umformtechnik
Content and module objectives	Contents: The module covers the basics of forming technology as well as selected forming processes and teaches their physical and technological relationships. Process chains for sheet metal and massively formed parts are developed and analysed, taking into account specified boundary conditions and requirements. The students learn about the special characteristics of cold and hot forming and apply this knowledge in the design and evaluation of different process chain variants – especially with regard to resource efficiency and flexibility. In addition, requirements for forming tools and machines are derived and the influence of central process parameters on the process window and component quality is explained. In addition, measures to ensure process stability and safety are considered. Module objectives: After completing the module, the students are able to: • Describe and explain the basics of forming technology and selected forming processes, • Develop and design process chains for sheet metal and solid components depending on the specified boundary conditions and requirements (e.g. production quantity), • describe the special features of cold and hot forming in the design of process chains, • identify process chain variants and evaluate them from the point of view of resource efficiency and flexibility, • derive the requirements for the forming tools and machines, • explain the influence of various parameters on the process window and thus on the quality of the formed part, and • explain measures to achieve process reliability.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Forming Process Chains (2 LVS) • Ü: Forming Process Chains (1 LVS) • P: Forming Process Chains (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of Production technology
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Forming Process Chains (Exam number: 34101) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Smart Manufacturing, Electives/Soft skills

Module number	231539-006 (Version 02)
Module name	Geometrical Product Specification and Verification
Module responsibility	Professorship of Production and Measurement Technology
Content and module objectives	Contents: Geometric product specifications are the basis for product development, simulation analysis, manufacturing, measurement, and more. The module presents an overview of the concept of Geometric Product Specification and Verification (GPS) described in international standards. Methods for non-verbal communication with symbols and rules for the complete and unambiguous description of geometric properties are presented. At the same time, associated metrological procedures are derived in order to record measurement data on the geometric properties of real workpieces. With the presentation of procedures for the selection of measurement technology and strategies, students are taught important basics for measuring geometric properties from functional and process-based perspectives. Exercises and internships complement the training in order to be able to use the GPS system and to be able to independently compare measured values with the specifications. Module objectives: After completing the module, students will understand the basic concepts of the GPS system. Theoretical and practical knowledge for solving fundamental questions regarding geometry description and evaluation is built up. The focus is on the function-oriented determination of geometric properties. The student is able to select metrology and measurement strategies for different measurement tasks and understands the information contained in the measurement results.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Geometrical Product Specification and Verification (2 LVS) • Ü: Geometrical Product Specification and Verification (1 LVS) • P: Geometrical Product Specification and Verification (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of construction and production technology.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minütige oral exam of Geometrical Product Specification and Verification (Exam number: 31719) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Smart Manufacturing, Electives/Soft skills

Module number	231533-021 (Version 04)
Module name	Cyber-Physical Production and Robot Systems
Module responsibility	Professorship of Production Systems and Processes
Content and module objectives	Contents: Basics, procedures and methods for the development, monitoring and control of modern mechatronic production systems are taught. Based on a detailed description, modelling and simulation of central components, tools for the evaluation and development of production systems are discussed. An in-depth examination of the collection of information, its transformation, forwarding and processing in the context of the Internet of Things will take place. Furthermore, the extension of process boundaries through the integration of actuator and sensory functionality close to the point of action is discussed. Automation is an essential link that complements the courses with the aspects of planning, regulating and monitoring movements in production systems. This includes an overview of systematic design methods as well as the structure, mode of operation, programming and operation of current control systems. Robots in industrial use are playing an increasing role in transport, assembly, manufacturing and other sub-processes. Using a universal robot (UR), a CNC-controlled robot and a PLC-based robot, differences as well as advantages and disadvantages are worked out. An introduction to programming and integration strategies completes this chapter. Module objectives: Upon completing the module, the students are able to: • to recognise and evaluate interdisciplinary relationships in the mechatronic system of machine tools, • describe individual components of machine tools and multi-machine systems, • implement the possibility of data collection and analysis according to the situation, • apply experimental and simulative methods for the identification of mechanical and control parameters, and • design the control system of typical drive solutions in mechanical engineering.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) and Practical work (P). • V: Cyber-Physical Production and Robot Systems (2 LVS) • Ü: Cyber-Physical Production and Robot Systems (1 LVS) • P: Cyber-Physical Production and Robot Systems (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of mechanics, machine elements and electrical engineering
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of the Lecture Cyber-Physical Production and Robot Systems (Exam number: 33642) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Smart Manufacturing, Electives/Soft skills

Module number	231533-020 (Version 04)
Module name	Machining Technologies
Module responsibility	Professorship of Production Systems and Processes
Content and module objectives	Contents: High-performance and efficient manufacturing technologies require optimal coordination of process parameters, tool selection and machine-specific process control. Tool path programming combines the geometric design of the workpiece with the technological requirements. With simple tool geometries, complex shapes can be created using suitable tool paths, with the NC program defining all the necessary movements and basic functions. The module deals with the development of an efficient process strategy, the creation of NC programs and the production of a component on the basis of a 3D CAD model or a drawing basis. Students acquire advanced practical skills in the machining process, tool and clamping device selection and independently create NC programs – first manually and then using CAM software. Finally, the manufacturing process is optimised to achieve maximum performance and efficiency. Module objectives: Nach Abschluss des Moduls sind die Studenten in der Lage, • Select machining operations and manufacturing parameters based on the geometric elements of a workspace, • set up a CNC milling machine under guidance and carry out the necessary set-up steps, • manually create NC programs for milling and turning operations, • to set up practice-oriented CAD/CAM or NC process chains, both for workshop oriented and external computer-aided programming, • describe workpiece geometries and select suitable machining strategies within a complex 3-axis and 5-axis CAM system with support, • analyze an existing manufacturing process and optimise it independently.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Machining Technologies (1 LVS) • Ü: Machining Technologies (1 LVS) • P: Machining Technologies (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of production processes.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: Creditable coursework: • 3 semester-related documents on practical tasks (Scope: approx. 2 pages each, 2 AS each) of Machining Technologies (Exam number: 33646) The academic achievement is credited if the grade of the academic achievement is at least "sufficient". The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Smart Manufacturing, Electives/Soft skills

Module number	231534-007 (Version 02)
Module name	Efficient Process Chains
Module responsibility	Professorship of Micromanufacturing Technology
Content and module objectives	Contents: This module covers the fundamentals and methodologies for designing resource-efficient processes and process chains. Following an overview of methods for structuring manufacturing processes and of technology and production planning, the module covers the technological fundamentals of selected machining, ablation and forming processes, with examples from the fields of thread production, hard and out-of-round machining, deep-hole drilling, dry machining, deburring, burr prevention and others. These are assessed and compared in terms of their resource efficiency within the context of the entire process chain. Process chains and equipment used in the manufacture of rotationally symmetrical and prismatic components in the mechanical engineering and automotive sectors are then explained and examined in greater detail using specific examples. Module objectives: After successful completion of the module, students will be able to: • explain reasons for the need to increase the efficiency of process chains, • explain the basic structure of process chains from semi-finished products to the finished workpiece for the production of rotationally symmetrical and prismatic components using a work sequence graph, • analyse existing process chains with regard to passible optimsation potential and develop proposed solutions
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Efficient Process Chains (2 LVS) • Ü: Efficient Process Chains (1 LVS) • P: Efficient Process Chains (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of production processes and technology
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Efficient Process Chains (Exam number: 32419) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231231-009 (Version 03)
Module name	Digital Ergonomics
Module responsibility	Professorship of Ergonomics and Innovation Management
Content and module objectives	Contents: To design work in a manner that is productive—as well as healthy, motivating, and conducive to well-being—working conditions must be adapted to human physiological, psychological, and cognitive prerequisites and capabilities. To this end, the module introduces analysis and design concepts grounded in work science through self-study materials; furthermore, through seminars and practical exercises, it imparts the specialized and methodological competencies required to apply these ergonomic concepts using advanced digital tools. Key topics include: • fundamental concepts of ergonomic work analysis and design • selected methods for ergonomic work analysis and design (ex: in the fields of anthropometry, physical forces, body posture and target times) • 3D modelling of work systems • modelling using digital human models • ergonomic analyses using digital human models • deriving ergonomic improvement measures based on a case study Module objectives: Students are able to apply the principles and rules of ergonomic work analysis and design—using selected digital tools—to practical examples. They are able to critically reflect upon the potential and limitations of digital ergonomics.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • S: Digital Ergonomics (2 LVS) • Ü: Digital Ergonomics (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Practical assignment to be completed throughout the semester (preparation of 5 digital solution documentation reports, duration: 2 weeks each, total workload: 35 contact hours) with a 20-minute final seminar on digital ergonomics (Exam number: 31221) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231232-014 (Version 05)
Module name	Simulation of Production and Logistics Systems
Module responsibility	Professorship of Factory Planning and Intra Logistics
Content and module objectives	Contents: In the module "Simulation of Production and Logistics Systems," students acquire the knowledge necessary to conduct simulation studies within the context of production and logistics systems. The theoretical component covers the following topics: an introduction to simulation and its fields of application, the use of simulation software, the modeling of technical systems, the fundamental methodology of simulation, and the workflow of a simulation study. The practical component focuses specifically on imparting skills in the application of simulation software, utilizing practical exercises drawn from the fields of production and logistics. Module objectives: Upon completion of this module, students will be able to dynamically analyze production and logistics systems using simulation software and to solve related problems.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Simulation of Production and Logistics Systems (2 LVS) • Ü: Simulation of Production and Logistics Systems (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of structuring and organisation of production and logistic systems
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Semester-long simulation study with documentation of results (Scope: 10 pages; Duration: 10 weeks) on Simulation of Production and Logistics Systems (Exam number: 31510) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231232-015 (Version 02)
Module name	Sustainable Smart Production
Module responsibility	Professorship of Factory Planning and Intra Logistics
Content and module objectives	Contents: • Industrial Production and sustainable development: System-theoretic foundations, factory and production systems, concepts of sustainable and smart production. • Structuring and organization of sustainable socio-technical systems: Corporate and production organization. • Systematic and sustainable factory and production design: Factory planning, work design, material flow and logistics, sustainability in production. • Operation of sustainable production systems: Operational control and digitalization of production. Module objectives: Upon completion of this module, students will possess fundamental and application-oriented knowledge regarding the design, organization, and management of sustainable industrial production systems within the context of digital transformation. They will be able to analyze and evaluate the structure and functions of a production facility from technical, organizational, and ecological perspectives. Furthermore, they will be able to systematically establish connections between the various disciplines involved in the planning and operation of production systems. Students will possess a holistic understanding of factory and production systems, as well as the interplay between humans, technology, and organization, with a specific focus on sustainability aspects. Moreover, they will be capable of applying key concepts of sustainable and smart production to modern industrial production systems.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Sustainable Smart Production (2 LVS) • Ü: Sustainable Smart Production (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Sustainable Smart Production (Exam number: 31519) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231231-011 (Version 02)
Module name	Applied Human Factors
Module responsibility	Professorship of Ergonomics and Innovation Management
Content and module objectives	Contents: This module provides an in-depth exploration of selected concepts and methods for the human-centred design of (socio)technical systems. The application of these concepts and methods is examined within the context of specific fields of practice and newly emerging technologies, and is situated within the current scientific discourse. The objective is the user-friendly, usable, and ethically sound design of products, work equipment, and complex systems. Professionals and managers in fields such as strategic management, technology management, development and design, ergonomics, and product and occupational safety—among others—require the corresponding competencies. Key topics include: • Fundamentals of human-centred system design • Human-centered design of mobility (driver-vehicle interaction, automated driving, multimodal mobility, etc.) • Human-centred design of industrial and service robotics • Use and design of virtual and mixed reality • Interaction with artifical intelligence and machine learning • The changing division of labor and collaboration between humans and technology. Module objectives: Students are familiar with concepts and master selected methods for the human-centered design of technical systems within selected fields of application. They are able to contextualize and apply these methods in practice, as well as reflect upon the results of their application.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Applied Human Factors (2 LVS) • Ü: Applied Human Factors (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Oral exam in small groups (15 Minutes per Student) of Applied Human Factors (Exam number: 31224) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231035-018 (Version 01)
Module name	Resilience in Manufacturing
Module responsibility	Professorship of Sports Equipment and Technology
Content and module objectives	Contents: The key thematic areas of the module are as follows: • Overview of key stages in the product lifecycle • Definition and significance of supply chains • Potential threats to supply chains, and methods for assessing, detecting, and mitigating these threats • Sustainability aspects in supply chains (economic, social, and ecological) • Identification of key technologies at both global and regional levels • Analysis of current risks and opportunities for the region regarding current and emerging key technologies • Development of recommendations for action for the regional economy and policymakers Module objectives: The students • are familiar with the elements of supply chains and are able to identify them for specific companies and document their interdependencies; • are capable of analyzing potential threats to the functioning of production processes by selecting and applying appropriate risk analysis methods; and • are able to structure and present the results of their research and analyses in a manner tailored to the specific target audience.
Teaching formats	Teaching format of the module is Seminar (S). • S: Resilience in Manufacturing (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • three 10-minute presentations and a written paper in the form of a set of recommendations for action (length: 10 pages; preparation time: 4 weeks) on a selected topic within the scope of the seminar (Exam number: 32826) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Industrial Engineering, Electives/Soft skills

Module number	231232-008 (Version 07)
Module name	Production Planning and Control
Module responsibility	Professorship of Factory Planning and Intra Logistics
Content and module objectives	Contents: • Objectives and Tasks of Production Planning and Control (PPC) • Data Foundations for PPC (Product Structure, Processes, Resources) • Company Typology and PPC Design • Production Program Planning • Requirements Determination, Inventory Planning, and Control • Scheduling and Capacity Planning • Order Release and Monitoring • Production Characteristics • Specialized Methods and Strategies • Setup and Implementation of PPC Systems Module objectives: Upon successful completion of the module, students are able to understand the essential interrelationships of production planning and control as well as order processing in industrial enterprises, to design the corresponding processes, and to apply the relevant methodological foundations in a goal-oriented manner. Furthermore, upon successful completion of the module, students are capable of evaluating modern planning and control strategies, determining the necessary prerequisites for their applicability, and applying them to selected situations within an operational environment.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Production Planning and Control (2 LVS) • Ü: Production Planning and Control (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points
Module exam	The module has one examination: • 120-minute exam of Production Planning and Control (Exam number: 31534) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities, Electives/Soft skills

Module number	231732-008 (Version 05)
Module name	Printed Materials
Module responsibility	Professorship of Welding Engineering
Content and module objectives	Contents: This module imparts in-depth knowledge regarding the behaviour of metallic materials and plastics during additive manufacturing and welding processes. The materials covered include steel, aluminium, titanium, nickel, and copper, as well as thermoplastics and cross-linking polymer systems. The module addresses the influence of processing and the thermal cycle on resulting material and component properties. Measures and strategies for improving processability and ensuring quality are discussed. Furthermore, material-specific failure cases in additively manufactured components and welded structures—along with their underlying causes—are examined. Module objectives: The students possess in-depth knowledge of the processing-induced material properties and thermally induced transformation processes of metallic materials. They are able to assess the processability of metallic materials and plastics in additive manufacturing and welding applications. Furthermore, they are capable of selecting suitable manufacturing processes for specific materials.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Printed Materials (2 LVS) • S: Printed Materials (2 LVS) The courses offered are supplemented by digital resources for self-study. The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamental knowledge about metals and plastics and about welding processes.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 10-minute Presentation and 10 minute oral defense (per student) for a group work (approx. 3-7 students per group) on a topic of Printed Materials (Exam number: 32703) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities, Electives/Soft skills

Module number	231732-015 (Version 01)
Module name	Additive Manufacturing
Module responsibility	Professorship of Welding Engineering
Content and module objectives	Contents: This module provides an overview of additive manufacturing technologies. The lecture focuses on solid-based processes and covers the following topics: a systematic classification and overview of additive techniques in 2D and 3D, design and layer formation, requirements for printable materials, functionalization, process chains, a comparison of various methods, and applications. The material groups examined include metals, ceramics, polymers, and concrete. The accompanying seminar involves group work centred on specific components or solution strategies within the field of additive manufacturing. Following guidance and an introduction to the subject matter, students form working groups to independently address a given task. Module objectives: Students possess a deep understanding of the systematics, functionality, and application scenarios of current technologies in the field of additive manufacturing. Students are able to independently develop and present solution strategies for specific applications while working in teams.
Teaching formats	Teaching format of the module are Lectures (V), Seminar (S) and Exercises (Ü). • V: Additive Manufacturing (2 LVS) • S: Additive Manufacturing (1 LVS) • Ü: Additive Manufacturing (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Project assignment as a group project (groups of up to 5 students; scope: approx. 3 pages per student; processing time: 6 weeks), including a 10-minute oral defense per student, on a topic from the Additive Manufacturing lecture. (Exam number: 32704) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities und Materials Engineering, Electives/Soft skills

Module number	231833-007 (Version 05)
Module name	Surface and Interface Engineering
Module responsibility	Professorship of Materials and Surface Engineering
Content and module objectives	Contents: This module covers surface and coating technology, as well as the design of interfaces in hybrid composites. A particular emphasis is placed on understanding the relationships between processing, structure, and properties. The module imparts knowledge regarding all essential processes for the fabrication of metallic, inorganic non-metallic, and organic layers and surface structures. Based on the complex requirements placed on surfaces and interfaces—arising from mechanical, tribological, corrosive, and thermal stresses—strategies for designing them to meet these specific demands are discussed. Module objectives: Students are familiar with the chemical, physical, and technological fundamentals of the key processes in surface and coating technology, including important pre- and post-treatment procedures. They recognize and understand the fundamental relationships between process characteristics and the resulting structures and properties of the coatings. They are capable of selecting coating systems based on specific application requirements and providing a well-founded justification for their choices.
Teaching formats	Teaching format of the module are Lectures (V), Seminar (S) und Practical Work (P). • V: Surface and Interface Engineering (2 LVS) • S: Surface and Interface Engineering (2 LVS) • P: Surface and Interface Engineering (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamentals of chemical bonding, atomic structure, the periodic table of elements, structure of crystalline materials, corrosion, and wear.
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Surface and Interface Engineering (Exam number: 32510) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities, Electives/Soft skills

Module number	231539-007 (Version 01)
Module name	Quality Assurance in Additive Manufacturing
Module responsibility	Professorship of Production Measurement Technology
Content and module objectives	Contents: Like traditional manufacturing processes, additive manufacturing is subject to process-related fluctuations and influencing factors that lead to geometric deviations in manufactured components. Within the scope of quality assurance, these deviations must be characterized. This lecture outlines the specific test planning steps and general conditions required for this purpose. The foundational content for this includes test planning methodologies, the system of Geometric Product Specification (GPS), and knowledge regarding both non-contact and conventional measuring instruments and techniques for AM components. The individual characterization of components—for instance, using 3D scanners and surface topography measurement systems with their associated parameters—along with the interpretation of measurement results, complements these fundamental quality assurance procedures. The accompanying exercises provide an in-depth exploration of both the differentiation and specification of geometric properties, as well as the configuration and measurement conditions of industry-relevant measurement systems. In the practical sessions, students evaluate the micro- and macro-properties of additively manufactured components and independently apply non-contact measurement techniques. Module objectives: Upon completion of the module, students are able to distinguish between geometric deviations in additively manufactured components and to select appropriate measurement methods and conditions for their characterization. Furthermore, they are able to define inspection planning steps and characterize geometric properties.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Quality Assurance in Additive Manufacturing (2 LVS) • Ü: Quality Assurance in Additive Manufacturing (1 LVS) • P: Quality Assurance in Additive Manufacturing (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minute oral exam of Quality Assurance in Additive Manufacturing (Exam number: 31721) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities, Electives/Soft skills

Module number	231732-007 (Version 04)
Module name	Structural Design of Additive Manufacturing Components
Module responsibility	Professorship of Welding Engineering
Content and module objectives	Contents: Advanced knowledge regarding the design of metallic AM components and welded joints—optimized for both manufacturing processes and operational loads—is taught. Furthermore, the load-bearing behaviour under static and cyclic loading, options for post-processing components and weld seams, and the analytical and numerical design of welded joints and additively manufactured components are covered. Students deepen their understanding of design rules, local and global calculation methods, and FEM simulations for selected components. Additionally, methods for quality assurance with respect to the mechanical and technological properties of components are acquired. Module objectives: The students possess in-depth knowledge regarding the design and calculation of metallic AM components and welded structures, and are capable of planning and designing AM components and welded structures in accordance with applicable regulations and standards.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Structural Design of Additive Manufacturing Components (2 LVS) • Ü: Structural Design of Additive Manufacturing Components (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of production technology, technical mechanics and finite element methods (FEM)
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Structural Design of Additive Manufacturing Components (Exam number: 32705) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Printed Functionalities, Electives/Soft skills

Module number	231732-014 (Version 01)
Module name	Joining of Additive Manufacturing Parts
Module responsibility	Professorship of Welding Engineering
Content and module objectives	Contents: This module imparts in-depth knowledge regarding applicable joining processes for assembling components generated via Additive Manufacturing (AM)—both with one another and with other semi-finished products. The primary focus lies on low-heat joining processes, such as screwing, bonding, brazing, pressure welding, and beam welding (laser and electron beam welding). The interrelationships between heat input, material degradation, component distortion, and residual stresses are explored in depth. Module objectives: Students will be familiar with the range of applications for the respective joining technologies and will be able to select appropriate joining processes for specific application scenarios.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) and Seminar (S). • V: Joining of Additive Manufacturing Parts (2 LVS) • Ü: Joining of Additive Manufacturing Parts (1 LVS) • S: Joining of Additive Manufacturing Parts (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	No
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Joining of Additive Manufacturing Parts (Exam number: 32710) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Materials Engineering, Electives/Soft skills

Module number	231834-008 (Version 01)
Module name	Materials Analysis
Module responsibility	Professorship of Electron Microscopy and Microstructural Analysis
Content and module objectives	Contents: Fundamentals of materials analysis methods, including materials microscopy, spectroscopic techniques, and the interpretation of measurement results: • Overview of key materials analysis methods, particularly for imaging, spectroscopy, and phase analysis • Technical design of instruments and detectors • Applicability of methods to specific problems • Sample preparation and execution of analyses • Options for qualitative and quantitative evaluation and interpretation of measurement results • Incorporation of specific issues related to materials engineering and materials science Module objectives: Upon successful completion of the module, students will be able to provide an overview of key methods in materials analysis and compare the technical and physical principles underlying these methods. Furthermore, they will be able to select appropriate methods based on specific materials-related problems and describe the practical and theoretical procedures involved, ranging from sample preparation to data evaluation.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Materials Analysis (2 LVS) • S: Materials Analysis (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Materials Analysis (Exam number: 34408) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Materials Engineering, Electives/Soft skills

Module number	231133-015 (Version 01)
Module name	Polymer Materials
Module responsibility	Professorship of Plastics Technology
Content and module objectives	Contents: Plastics are classified into thermoplastics, thermosets, and elastomers based on their thermo-mechanical behavior. Furthermore, their processing and application-related properties can be modified through a variety of methods—such as plasticizing, foaming, filling, reinforcing, cross-linking, blending, copolymerizing, etc. Consequently, the properties of the finished products depend not only on the specific type of plastic but also on the physical processes and/or chemical reactions occurring during processing. Process-structure-property relationships are explained and explored in greater depth through experiments. In addition, selected specialized plastic testing methods are presented. Module objectives: Upon successful completion of the module, students will be able to describe the material behavior of the main groups of plastics, identify ways to modify plastic properties to optimally utilize material potential, and assess component behavior and areas of application.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Polymer Materials (2 LVS) • S: Polymer Materials (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 35-minute Colloquium (20-minute Presentation in a group of 4 students and 15-minute oral exam per student) of Polymer Materials (Exam number: 32121) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Materials Engineering, Electives/Soft skills

Module number	231133-016 (Version 01)
Module name	Polymer Processing
Module responsibility	Professorship of Plastics Technology
Content and module objectives	Contents: The course begins with an introduction to the fundamentals of plastics as synthetic polymeric materials, covering their processing behavior and potential manufacturing methods. In-depth analysis follows, using complex case studies to examine high-quality plastic applications in automotive engineering, equipment and vessel construction, and general plastics technology. For thermoplastic, thermoset, elastomeric, and multi-component plastic designs, the entire development process is detailed—from defining component requirements and selecting materials and semi-finished products (including design procedures) to manufacturing and testing—while highlighting the potential for utilizing plastic materials. The curriculum also covers specialized injection molding techniques and surface finishing, specific aspects of injection mold making, and dedicated testing procedures for technical components. Module objectives: Upon successful completion of the module, students possess in-depth knowledge regarding the design, manufacturing, and testing of plastic components subjected to high and very high loads. They are able to apply their knowledge to analogous application scenarios.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Polymer Processing (2 LVS) • S: Polymer Processing (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 35-minute Colloquium (20-minute Presentation in a group of 4 students and 15-minute oral exam per student) of Polymer Processing (Exam number: 32122) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Materials Engineering, Electives/Soft skills

Module number	231832-009 (Version 01)
Module name	Materials Testing
Module responsibility	Professorship of Materials Engineering
Content and module objectives	Contents: Students learn current methodological approaches and practical techniques for destructive and non-destructive materials testing. Through practical application in laboratory experiments and by examining current research examples, they gain the ability to evaluate typical measurement results and characteristic values within the context of technically or scientifically relevant issues. Module objectives: The students have mastered current materials testing methods. They are capable of quantitatively determining and qualitatively evaluating the mechanical and other physical properties of materials, as well as validating the suitability of various testing methods under application-oriented conditions from the perspective of production and materials engineering.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Materials Testing (2 LVS) • Ü: Materials Testing (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamentals in the field of materials and elementary technical mechanics
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Materials Testing (Exam number: 33506) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Materials Engineering, Electives/Soft skills

Module number	231831-014 (Version 01)
Module name	Lightweight Metals and Ceramics
Module responsibility	Professorship of Composites and Material Compounds
Content and module objectives	Contents: This module covers key metallic and ceramic lightweight materials—specifically technical ceramics, aluminum- and titanium-based light metals, and selected high-strength lightweight steels. The focus is on manufacturing routes, characteristic processing properties, and the resulting mechanical-technological parameters. The material families are systematically compared and analyzed regarding their performance in current and future lightweight applications. In the accompanying exercises, the lecture content is applied and deepened through targeted material selection and design tasks, as well as the analysis of property data. Module objectives: Upon successful completion of the module, the students can • classify the manufacturing and processing methods for the lightweight materials in question and link them to the resulting properties, • evaluate ceramic and metallic lightweight materials regarding their suitability for selected applications • select suitable materials and combinations for specific design tasks and provide a technical justification for their decisions, and • critically reflect on the opportunities and limitations of the respective material concepts in lightweight construction.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Lightweight Metals and Ceramics (2 LVS) • Ü: Lightweight Metals and Ceramics (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge in the field of materials engineering and technology
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Lightweight Metals and Ceramics (Exam number: 33325) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231131-004 (Version 04)
Module name	Sichere Mechatronische Systeme/Safe Mechatronic Systems
Module responsibility	Professorship of Conveying Engineering and Materials Handling
Content and module objectives	Contents: This module provides in-depth knowledge of safety technology, specifically addressing and distinguishing between key safety-related terms and their definitions. In addition to an introduction to relevant technical standards, the course focuses on their practical application for identifying and assessing risks. Associated with this is a detailed examination of safety quantification using mathematical models. The module also explores the concepts of Performance Level (PL) versus Safety Integrity Level (SIL) and their significance in practical applications. Furthermore, it discusses safety concepts and their implementation in design, as well as safety functions within mechatronics. Specific topics include safe bus systems, sensors, actuators, and control systems, along with a distinction between safety systems and assistance systems. Examples of safe mechatronic systems from fields such as materials handling, drive technology, control engineering, and communication technology illustrate these safety aspects and demonstrate design implementations for integrated safety in industrial environments. Module objectives: Upon successful completion of the module the students can: • explain the general significance of safety and safety technology, • identify and apply technical standards in the field of machine safety, • define the term "risk" within the context of safety technology, • describe the risk assessment process and apply it to specific cases, • distinguish between and apply relevant approaches to quantifying safety, • outline proven safety concepts, • describe safety functions and perform their validation, and • cite examples of safety-related aspects.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Sichere Mechatronische Systeme/Safe Mechatronic Systems (2 LVS) • Ü: Sichere Mechatronische Systeme/Safe Mechatronic Systems (1 LVS) The courses are held in German during the winter semester and in English during the summer semester.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 150-minute exam of Sichere Mechatronische Systeme/Safe Mechatronic Systems (Exam number: 31930) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231534-021 (Version 01)
Module name	Data Acquisition and Analysis of Manufacturing Processes
Module responsibility	Professorship of Micromanufacturing Technology
Content and module objectives	Contents: The module focuses on imparting a solid foundational understanding of how to analyze and evaluate manufacturing processes using process-relevant data. It covers machining, force-based, and material-removal processes, as well as the mechatronic systems required to implement them. To facilitate the acquisition, processing, and analysis of process-inherent data, the module introduces relevant measurement principles and the associated measurement chains. Additionally, it covers signal conditioning, filtering techniques, and methods of analysis. Through a seminar component, participants consolidate their skills by working on concrete practical tasks involving measurement data acquisition and computer-aided analysis. Module objectives: Upon successful completion of the module, students will be able to: • name and describe relevant parameters and measurement principles for acquiring process data, • explain the measurement chains required for data acquisition and compare different measurement principles, • independently set up measurement chains and acquire process data, • describe and apply various methods of signal conditioning and analysis.
Teaching formats	Teaching of the module are Lectures (V), Exercises (Ü) and Seminar (S). • V: Data Acquisition and Analysis of Manufacturing Processes (1 LVS) • Ü: Data Acquisition and Analysis of Manufacturing Processes (1 LVS) • S: Data Acquisition and Analysis of Manufacturing Processes (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Data Acquisition and Analysis of Manufacturing Processes (Exam number: 32428) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231536-007 (Version 01)
Module name	Components and Integration of Mechatronic Systems
Module responsibility	Professorship of Adaptronics and Light-weight Design (in Production)
Content and module objectives	Contents: This module covers the theoretical foundations of cross-domain design and the modeling of mechatronic systems, alongside application-oriented skills for using simulation to support the development process. The starting point is a perspective of mechatronic systems comprising a basic structure, sensors, actuators, and information processing components. The scientific approach to selecting and designing these individual elements is examined, with a particular focus on sensor-actuator systems and the communication methods within them. Finally, the module addresses the integrated development of CAD models and simulation models for designing open-loop and closed-loop control systems. Module objectives: Upon completion of the module, students are able to: • use methodologically sound approaches to design mechatronic systems, • develop cross-domain models for their analysis, • select sensors and actuators suitable for a specific application, • integrate the overall system in terms of both software and hardware, and • verify and validate mechatronic systems based on defined requirements.
Teaching formats	Teaching formats of the module are Lectures (V) and Practical work (P). • V: Components and Integration of Mechatronic Systems (2 LVS) • P: Components and Integration of Mechatronic Systems (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Components and Integration of Mechatronic Systems (Exam number: 31413) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231534-020 (Version 01)
Module name	Design and Realisation of Mechatronic Systems I
Module responsibility	Professorship of Micromanufacturing Technology
Content and module objectives	Contents: A technical assignment is to be completed in groups (4–6 students). Following research into the state of the art (patents, literature, existing products, etc.), the necessary work steps, division of labor, and required resources for solving the task must be planned. The project may be carried out—either wholly or in part—in collaboration with an industry partner. The content to be developed by the students is supported by lectures on the design of mechatronic systems, project management, and systematic design methodology. Results must be presented in an interim presentation and a short report; based on these, a refined approach for implementation in the "Design and Realisation of Mechatronic Systems II" module must be formulated. Module objectives: After successful completion of the module, the students can: • conceive and plan a technical project as part of a team, • apply project management knowledge to a technical project, • document and prepare the results of the technical project and present them in both written and oral form.
Teaching formats	Teaching format of the Module is Seminar (S) • S: Design and Realisation of Mechatronic Systems I (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Oral interim presentation (5 minutes per student) and short written report (length: 5 pages per student; working period: throughout the semester until the end of the lecture period) on the group project (state of the art, refined problem statement, planned approach, team roles/division of tasks, required resources) in Design and Realisation of Mechatronic Systems I (Exam number: 32429) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

Annex 2: Module description for the English-language consecutive study program Advanced Manufacturing with the degree Master of Science (2026)

Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231536-008 (Version 01)
Module name	Design and Realisation of Mechatronic Systems II
Module responsibility	Professorship of Adaptronics and Light-weight Design (in Production)
Content and module objectives	Contents: The objectives defined in *Design and Realisation of Mechatronic Systems I* are to be implemented and subsequently verified or demonstrated using a demonstrator or prototype (including software). The work is to be carried out largely independently under the supervision of the participating professorship(s) and, where applicable, the participating industry partners. Group work is complemented by specialized lectures covering scientific working methods, manufacturing technologies for mechatronic systems, the selection of electronic components, microcontroller programming, and practical examples of mechatronic system implementation. Module objectives: Upon successful completion of the module, students are able to: • design mechatronic systems across domains, taking into account the interdependencies between the various disciplines, • implement a technical project from a manufacturing perspective, considering the required resources, • methodically verify and validate the characteristics of mechatronic systems, • document and prepare the results of the technical project and present them in both written and oral form.
Teaching formats	Teaching format of the Module is Seminar (S) • S: Design and Realisation of Mechatronic Systems II (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Fulfilling the admission requirements for the examination component and successfully passing the module examination are prerequisites for the awarding of credits. The requirement to get admission into this module is passing the Module 231534-020 Design and Realisation of Mechatronic Systems I
Module exam	The module has one examination: • Oral final presentation (5 minutes per student) and short written report (length: 5 pages per student; working period: throughout the semester until the end of the lecture period) on the group project (project content, scientific-technical approach, challenges and solutions, results, resources used) for Design and Realisation of Mechatronic Systems II (Exam number: 31414) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Mechatronics and Automation, Electives/Soft skills

Module number	231536-009 (Version 01)
Module name	Advanced Mechatronic Systems
Module responsibility	Professorship of Adaptronics and Light-weight Design (in Production)
Content and module objectives	Contents: This module covers the methodological foundations of the design and development process for mechatronic systems. It begins by addressing the fundamental structure and integration levels of mechatronic systems, extending these concepts to the further development of adaptronic systems. The module also provides an overview of development tools for handling complex system behavior, alongside in-depth knowledge regarding the modeling and design of mechatronic systems using multi-body simulation and multiphysics simulation methods. A key aspect of system design is compliance with statutory safety requirements for the construction of safe mechatronic systems; the module outlines the methodological approach to risk assessment and explains the parameters defining safe mechatronic systems. Selected examples serve to deepen understanding of the mechatronic system design process and illustrate concrete design implementations within an industrial context. Module objectives: Upon successful completion of the module, the students are able to: • to identify and describe the components of mechatronic systems, • to recognize interdisciplinary interrelationships in system development and take them into account during the development process, • to select appropriate development tools for designing mechatronic systems for specific applications, • to confidently design and evaluate mechatronic systems.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Advanced Mechatronic Systems (2 LVS) • S: Advanced Mechatronic Systems (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Advanced Mechatronic Systems (Exam number: 31415) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	220000-706 (Version 01)
Module name	Topics in Numerical Methods
Module responsibility	Dean of Studies for all degree programs in the Faculty of Mathematics (excluding the Foundations in Data Science, Data Science, MINT, and Advanced and Computational Mathematics programs)
Content and module objectives	Contents: Selected topics in numerical mathematics, such as • • number representation and rounding errors, • conditioning and numerical stability, • numerical solution of systems of linear equations, • systems of nonlinear equations, • interpolation and approximation of functions, • numerical integration (quadrature), • numerical solution of initial value problems for ordinary differential equations, or • numerical solution of partial differential equations Module objectives: Students can explain the fundamentals of computer arithmetic and the concept of rounding errors. They possess an overview of basic mathematical tasks, such as solving systems of equations, interpolation, approximation, and quadrature. They are able to evaluate methods, particularly through error analysis and with regard to conditioning and stability. Various numerical methods can be implemented and applied using a programming language.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Topics in Numerical Methods (4 LVS) • Ü: Topics in Numerical Methods (2 LVS)
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 60-minute exam of Topics in Numerical Methods (Exam number: 20301) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	231537-008 (Version 01)
Module name	Simulation in der Fertigungstechnik/Simulation in Manufacturing Engineering
Module responsibility	Professorship of Umformtechnik

Content and module objectives	Contents: Finite Element Method (FEM) simulations are essential components in the design and analysis of manufacturing processes and, consequently, key elements of digitalization and digital twins. Manufacturing processes are influenced by various parameters, such as mechanical quantities, temperature, and electromechanical factors. Various nonlinearities arise—including large deformations, plasticity, contact, and friction—as well as interactions within multiphysics systems. During their bachelor's studies, students from various disciplines are typically introduced only to approaches for linear FEM problems, or—in the case of nonlinear problems—there is often no link established with experimental data. The module focuses on the following key areas:
	• Application areas of the Finite Element Method (FEM)
	• Physical background of FEM in manufacturing technology (discretized force equilibrium, energy balance and heat conduction, material modeling, time discretization)
	• Structure and functioning of FEM systems
	• FEM-theory, modelling and simulations methods in the fields of:
	  ○ Forming technology (sheet metal and bulk forming, shear cutting)
	  ○ Separation technology (machining processes, chemical and thermal material removal processes)
	  ○ Joining technology (mechanical and thermal processes)
	• Simulation examples
	• Validation of simulations against experimental data from manufacturing experiments
	• Selected FEM systems for manufacturing technology, automotive production and hydrogen technologies.
	
	Module objectives: Upon successful completion of the module, students possess practical expertise regarding the structure, function, and application of FE simulation in manufacturing technology. They have acquired fundamental knowledge of FE simulation applied to manufacturing problems in the fields of forming, cutting, and joining. They are capable of independently using a standard FEM system to simulate manufacturing processes. The module imparts the skills to critically evaluate the results of FEM simulations in terms of their utility and relevance for the design and analysis of manufacturing processes.

Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Simulation in der Fertigungstechnik/Simulation in Manufacturing Engineering (2 LVS) • S: Simulation in der Fertigungstechnik/Simulation in Manufacturing Engineering (2 LVS) The teaching events are held in German in the winter semester and in English in the summer semester.
Requirements for participation (recommended knowledge and skills)	Fundamental knowledge of production technology and of linear finite element methods
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination:

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	• 120-minute exam of Simulation in der Fertigungstechnik/Simulation in Manufacturing Engineering (Exam number: 34103) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	231431-012 (Version 06)
Module name	Applied Modelling and Simulation in Solid Mechanics I
Module responsibility	Professorship of Solid mechanics
Content and module objectives	Contents: The module begins by covering the fundamentals of linear continuum mechanics and material modeling. Building on this, it introduces the linear finite element method (FEM), with a focus on the application of commercial FEM software. • Representation and calculation rules for tensors • Invariants, eigenvalues, and eigenvectors • Strain and stress tensors • Rheological equivalent models, elasticity, and viscoelasticity • Solution algorithm for linear FEM • Element types and numerical integration Module objectives: Upon successful completion of the module, students are able to solve linear problems in solid mechanics and thus perform the tasks of a development and analysis engineer in the field of computer-aided component simulation.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Applied Modelling and Simulation in Solid Mechanics I (2 LVS) • Ü: Applied Modelling and Simulation in Solid Mechanics I (2 LVS) Die Lehrveranstaltungen des Moduls werden in englischer Sprache abgehalten.
Requirements for participation (recommended knowledge and skills)	Course on engineering mechanics spanning at least two semesters
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Applied Modelling and Simulation in Solid Mechanics I (Exam number: 31819) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	231431-013 (Version 02)
Module name	Applied Modelling and Simulation in Solid Mechanics II
Module responsibility	Professorship of Solid Mechanics
Content and module objectives	Contents: The module covers the fundamentals of geometrically and physically nonlinear continuum mechanics and material modeling. Furthermore, it provides an introduction to the nonlinear finite element method (FEM), with a focus on the application of commercial FEM software. • Eulerian and Lagrangian descriptions • Strain and stress tensors, time derivatives of tensors • Rheological constitutive models, nonlinear elasticity, viscoelasticity, and plasticity • Solution algorithm for nonlinear FEM • Contact Module objectives: Upon successful completion of the module, students are able to analyse nonlinear problems in solid mechanics and thus perform the tasks of a development and analysis engineer in the field of computer-aided component simulation.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Applied Modelling and Simulation in Solid Mechanics II (2 LVS) • Ü: Applied Modelling and Simulation in Solid Mechanics II (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of Applied Modelling and Simulation in Solid Mechanics I
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minute oral exam of Applied Modelling and Simulation in Solid Mechanics II (Exam number: 31820) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	231435-015 (Version 01)
Module name	Computational Methods of Heat Transfer
Module responsibility	Professorship of Technical Thermodynamics
Content and module objectives	Contents: Heat transfer problems arise in a wide range of manufacturing processes—for instance, involving controlled heating or cooling. Since such problems can only be solved analytically in highly simplified scenarios or empirically in select standard cases, numerical methods have become an integral part of engineering research and development. Following a brief overview of analytical and empirical calculation methods, the module introduces simulation software based on CFD (Computational Fluid Dynamics) by discussing key considerations for numerical solution techniques. Instruction on using the software is provided through practical examples from the field of heat transfer. Successful mastery of the material is demonstrated through the completion of an individual assignment and the presentation of the results. Module objectives: Upon successful completion of the module, students are able to apply analytical, empirical, and numerical methods to solve typical engineering problems; work independently with simulation software to numerically solve heat transfer problems and evaluate the calculated results; and summarize and defend their findings—both in writing and orally—in accordance with scientific standards.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Computational Methods of Heat Transfer (1 LVS) • Ü: Computational Methods of Heat Transfer (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamental knowledge of Technical Thermodynamics-1, Heat Transfer and Fluid Mechanics
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Project work (CFD model with relevant files; scope: approx. 60 working hours; duration: 10 weeks), including a 25-minute presentation and a subsequent 20-minute oral examination on the project, for the course "Computational Methods of Heat Transfer" (Exam number: 33228) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Specialization Computational Manufacturing Engineering, Electives/Soft skills

Module number	231432-007 (Version 01)
Module name	Computational Modelling of Thermo-Mechanically Coupled Processes
Module responsibility	Professorship of Applied Mechanics and Dynamics
Content and module objectives	Contents: Considering thermal processes when simulating the dynamics of mechanical structures is particularly important in production processes involving thin, lightweight structures—such as polymer composites—because these utilize materials exhibiting pronounced inelastic behavior. In reality, this material behavior is coupled with a dependence on both component and ambient temperatures. This module addresses the modeling and numerical simulation of the thermodynamics of such structures under both small and large deformations, thereby considering complex motions in addition to vibrations. The modeling encompasses both discrete masses and continuous bodies. Modern nonlinear finite element methods—addressing both the temporal and spatial domains—are employed for simulation, while analytical solutions are developed to validate the numerical results. Module objectives: The students are able to independently model complex thermo-mechanically coupled dynamic systems, simulate them numerically, and validate them using analytical solutions.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Computational Modelling of Thermo-Mechanically Coupled Processes (2 LVS) • S: Computational Modelling of Thermo-Mechanically Coupled Processes (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamental knowledge of applied dynamics (ex: Module Technische Mechanik III)
Module application	---
Requirements for awarding of credit points	Successful completion of the modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minute oral examination with 15 minutes of preparation time on Computational Modelling of Thermo-Mechanically Coupled Processes (Exam number: 33009) The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136004-017 (Version 01)
Module name	Deutsch für Ingenieure (Maschinenbau) (Niveau B1+)
Module responsibility	Head of the German as a Foreign Language Department, Centre for Foreign Languages
Content and module objectives	Contents: • Practice of all language skills—listening, speaking, reading, and writing—using selected topics related to technical terminology and everyday academic life in engineering • Practice of formal and informal written and, in particular, oral communication in student and professional contexts (e.g., job application training, workplace communication) • Consolidation and expansion of grammatical structures through exercises focusing on lexical and morphosyntactic structures The training is aligned with language proficiency level B1 of the Common European Framework of Reference for Languages (CEFR). Module objectives: • Understand the main content of common texts on engineering topics • Understand and write texts on professional topics • Report on experiences and events in an engineering context using simple language • Describe, justify, and explain simple processes • Present one's own point of view on familiar engineering topics Completion of the module corresponds to language proficiency level B1 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching format of the module are Exercises (Ü) und Praktikum(P). • Ü: German Language Course for Engineers (Mechanical Engineering) (4 LVS) • Ü: Engineering Communication (Mechanical Engineering) (1 LVS) • P: Engineering Practice (Mechanical Engineering) (1 LVS)
Requirements for participation (recommended knowledge and skills)	Completion of the preceding Course 3 or placement test (recommendation for qualification)
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module examination consists of two assessment components. Specifically, the following assessment components must be completed: Recognizable academic achievements: • 70-minute exam for the German for Engineers (Mechanical Engineering) vocational language course (Exam number: 91829) • 3 oral group assignments conducted during the semester (1. role-play, 2. presentation, 3. simulation of a professional situation)—each lasting approximately 5 minutes per student—for the Engineering Communication (Mechanical Engineering) practice course. (Exam number: 91834). Academic work is credited provided the grade obtained is at least "sufficient."

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Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations. Examination requirements: Recognizable academic achievements: • Written exam for the German for Engineers (Mechanical Engineering) vocational language course, Weight 7 • Semester-long oral group assignments for the Engineering Communication (Mechanical Engineering) practical course, Weight 3
Module frequency	The module is offered in every semester
Workload	The module comprises a total student workload of 150 hours (90 contact hours and 60 hours of independent study).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136004-007 (Version 02)
Module name	Deutsch als Fremdsprache III (Niveau B1)
Module responsibility	Head of the German as a Foreign Language Department, Centre for Foreign Languages
Content and module objectives	Contents: • Exercises to expand vocabulary and improve speaking skills • Communicative situations and tasks covering topics such as time and wasting time, leisure, daily routine, university studies, work and careers, and modern media • Review and consolidation of basic grammar, along with the introduction of additional grammatical structures, including the passive voice and subordinate clauses The training is aligned with language proficiency level B1 of the Common European Framework of Reference for Languages (CEFR). Module objectives: • Improvement of speaking skills; making simple, coherent statements about familiar topics • Reporting on experiences and events; describing goals and plans; providing reasons and explanations • Communicating using simple linguistic means • Understanding and writing texts on everyday topics Completion of the module corresponds to language proficiency level B1 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching format of the module is Exercise (Ü). • Ü: Kurs 3 (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completion of preceding Course 2 or placement test (recommendation for qualification)
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: Recognizable academic achievement : • 90-minute exam of Kurs 3 (Exam number: 91805) Academic work is credited provided the grade obtained is at least "sufficient."
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester
Workload	The module comprises a total student workload of 150 hours (90 contact hours and 60 hours of independent study).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136001-004 (Version 02)
Module name	Englisch in Studien- und Fachkommunikation III (Niveau C1)
Module responsibility	Head of the English Department, Centre for Foreign Languages
Content and module objectives	Contents: Deepening of specialized vocabulary in selected areas and systematic expansion of general vocabulary relating to academic, professional, and intercultural contexts; conducting consultations and discussions; delivering presentations; The training is aligned with the C1 proficiency level of the Common European Framework of Reference for Languages (CEFR) and includes a specialized language component. Module objectives: Confidence in the oral and written exchange of information and in oral and written expression, confidence in giving presentations, and the acquisition of intercultural competencies; Completion of the module corresponds to language proficiency level C1 of the Common European Framework of Reference for Languages (CEFR), with a focus on specialized language.
Teaching formats	Teaching format of the module is Exercise (Ü). • Ü: Kurs 3 Advanced English in job-related situations (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completion of the module "English for Academic and Professional Communication II" (Level B2) or placement test (recommendation for qualification)
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module examination consists of two exams which must be completed: Recognisable academic performance: • 120-minute written exam for course 3 (examination number: 91203) • 30-minute oral examination (presentation) for course 3 (examination number: 91225) The coursework is credited if the grade of the coursework is at least 'sufficient'
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations. Examinations: Recognisable academic performance • Written exam for course 3, Weight: 4 (4 CP) • Oral examination (presentation) for course 3, Weight 1 (1 CP)
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a student workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136001-006 (Version 03)
Module name	Englisch in Studien- und Fachkommunikation V (Niveau C1)
Module responsibility	Head of the English Department of the Center for Foreign Languages
Content and module objectives	Contents: Teaching advanced knowledge and skills in the scientific and technical use of the English language with a focus on the linguistic and stylistic requirements of a technical working environment. The programme is based on language competence level C1 of the Common European Framework of Reference for Languages (CEFR) and includes a technical language component. Module objectives: Professionalisation in the use of English as a scientific language; training and expansion of communicative and interactive skills; confidence in presentations in compliance with formal criteria; achieving a stylistic range of variation in oral and written expression Completion of the module corresponds to language competence level C1 of the Common European Framework of Reference for Languages (CEFR) with a technical language orientation.
Teaching formats	Teaching forms of the module are Exercises (Ü). • Ü: Course 4 Scientific Writing and Speaking (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completion of the module English in Academic and Specialised Communication II (level B2) or placement test (qualification recommendation)
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module examination consists of two assessed components. Specifically, the following assessments must be completed: Assessable coursework: • Written "Academic Paper" (length: 1,000 to 1,500 characters; completion period: 3 weeks) followed by a 30-minute oral presentation and defense of the paper on a selected topic from the practical course (Exam number: 91220) • Oral group discussion (approx. 15 minutes per participant) regarding the practical course (Exam number: 91219) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations. Examination requirements: Assessable coursework: • Written "academic paper" followed by an oral presentation and defense of the paper on a selected topic from the exercise; Weight: 1 • Oral group discussion regarding the exercise; Weight: 1
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a student workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136001-007 (Version 02)
Module name	Englisch in Studien- und Fachkommunikation VI (Niveau C1)
Module responsibility	Head of the English Department of the Center for Foreign Languages
Content and module objectives	Contents: Independent research, reading and linguistic evaluation of subject-specific texts as well as application in technical discussions. Consolidation of academic/professional vocabulary in the specialised field, leading consultations and discussions in a technical working environment. The programme is based on language competence level C1 of the Common European Framework of Reference for Languages (CEFR) and includes a technical language component. Module objectives: Independent reception of specialist texts and use of specialist terminology, presentation of subject-specific facts and leading discussions on the topic, professionalization in the use of English as a scientific language. Completion of the module corresponds to language competence level C1 of the Common European Framework of Reference for Languages (CEFR) with a technical language orientation
Teaching formats	Teaching forms of the module are tutorials. • T: Course 5 Subject-specific Reading (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completion of the module English in Academic and Specialised Communication II (level B2) or placement test (qualification recommendation)
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of one examination: Recognisable academic performance: • 30-minute oral summary of a specialised text and discussion of the topic as part of three tutorials in course 5 (examination number: 91227) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a student workload of 150 WH (working hours) (10 Contact hours and 140 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136005-001 (Version 02)
Module name	Französisch I (Niveau A1)
Module responsibility	Head of the French Department of the Center for Foreign Languages
Content and module objectives	Contents: • Teaching basic knowledge of the French language (lexis, grammar, phonetics) and regional/cultural characteristics • Vocabulary of simple topics: Family and friends, language skills, daily routine, eating habits, leisure activities, place of residence/accommodation • Grammatical structures: articles, nouns, adjectives, adverbs, tenses (présent and passé composé), personal pronouns, negation • Communication structures: introducing/describing yourself and others, describing/asking for directions, expressing simple goals, reporting on the past • The course is based on language competence level A1 of the Common European Framework of Reference for Languages (CEFR). Module objectives: Students can understand and use everyday expressions and very simple sentences aimed at satisfying specific needs. They can introduce themselves and others and ask other people questions about themselves. Completion of the module corresponds to language competence level A1 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching forms of the module are exercises. • E: Course 1 (4 LVS)
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of one examination: Recognisable academic performance: • 90-minute written examination for course 1 (examination number: 91301) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a student workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136005-002 (Version 02)
Module name	Französisch II (Niveau A2)
Module responsibility	Head of the French Department of the Center for Foreign Languages
Content and module objectives	Contents: • Expansion and consolidation of vocabulary and grammar • Regional/cultural specialities • Vocabulary: education, family, hobbies, leisure and work • Grammatical structures: (non-)regular verbs, comparative adjectives and adverbs, modal verbs, reflexive verbs, possessive pronouns, demonstrative antecedents, direct and indirect object pronouns, adverbial pronouns y and en, relative pronouns, futur composé, comparison of imparfait and passé composé • Communication structures: talking about habits, making suggestions, making plans, reporting on and evaluating experiences The course is based on language competence level A2 of the Common European Framework of Reference for Languages (CEFR). Module objectives: Students can understand sentences and frequently used expressions related to their area of life. They can communicate orally and in writing in simple routine situations. Completion of the module corresponds to language competence level A2 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching forms of the module are Exercises (Ü). • Ü: Course 2 (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completed previous course 1 or placement test (qualification recommendation)
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of one examination: Recognisable academic performance: • 90-minute written examination for course 2 (examination number: 91302) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a students' workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136009-001 (Version 02)
Module name	Spanisch I (Niveau A1)
Module responsibility	Head of the Spanish Department of the Center for Foreign Languages
Content and module objectives	Contents: • Teaching basic knowledge of the Spanish language (vocabulary, grammar, phonetics) and regional/cultural characteristics • Vocabulary on simple topics: Family and friends, language skills, daily routine, eating habits, leisure activities, place of residence/accommodation • Grammatical structures: articles, nouns, adjectives, adverbs, tenses (presente and pretérito perfecto), personal pronouns, negation • Communication structures: introducing/describing yourself and others, describing/asking directions, expressing simple goals, reporting on the past The course is based on language competence level A1 of the Common European Framework of Reference for Languages (CEFR). Module objectives: Students can understand and use everyday expressions and very simple sentences aimed at satisfying specific needs. They can introduce themselves and others and ask other people questions about themselves. Completion of the module corresponds to language competence level A1 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching forms of the module are Exercises (Ü). • Ü: Course 1 (4 LVS)
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of one examination: Recognisable academic performance: • 90-minute written examination for course 1 (examination number: 91601) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a students' workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	136009-002 (Version 02)
Module name	Spanisch II (Niveau A2)
Module responsibility	Fachgruppenleiter Spanisch des Zentrums für Fremdsprachen
Content and module objectives	Contents: • Expansion and consolidation of vocabulary and grammar • Regional/cultural specialities • Vocabulary: education, family, hobbies, leisure and work • Grammatical structures: (non-)regular verbs, modal verbs, reflexive verbs, possessive pronouns, direct and indirect personal pronouns, relative pronouns, comparison of pretérito indefinido and perfecto • Communication structures: talking about habits, making suggestions, making plans, reporting and evaluating experiences The course is based on language competence level A2 of the Common European Framework of Reference for Languages (CEFR). Module objectives: Students can understand sentences and frequently used expressions related to their area of life. They can communicate orally and in writing in simple routine situations. Completion of the module corresponds to language competence level A2 of the Common European Framework of Reference for Languages (CEFR).
Teaching formats	Teaching forms of the module are Exercises (Ü). • (Ü): Course 2 (4 LVS)
Requirements for participation (recommended knowledge and skills)	Completed previous course 1 or placement test (qualification recommendation)
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of one examination: Recognisable academic performance: • 90-minute written examination for course 2 (examination number: 91602) The academic performance is recognised if the grade of the academic performance is at least 'sufficient'.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered in every semester in an academic year
Workload	The module comprises a students' workload of 150 WH (working hours) (60 Contact hours and 90 Self-study hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	231833-010 (Version 01)
Module name	Electroplating and Thermal Coating
Module responsibility	Chair of Materials and Surface Engineering
Content and module objectives	Contents: The module follows on from the 'Surface and Interface Engineering' module in terms of content and expands on this with regard to industrially relevant coating processes. The focus here is on the topics of 'Electroplating' and 'Thermal Coating'. **Electroplating:** Relevant topics of wet-chemical coating processes are addressed and comprehensively taught. Contents are • Electrochemical fundamentals • Modelling of electrochemical processes • Fundamentals of electroplating technology • Coating systems • Coating processes • Electrochemical analysis • Coating characterisation **Thermal coating:** The following thermal coating processes or groups of coating processes are analysed in more detail: • Thermal spraying • Deposition welding • CVD process • PVD process For these coating processes, the environmental relationships of the coating process and cross-process issues relating to the selection methodology for coatings are dealt with. As both galvanic and thermal coatings are primarily used in tribological and/or chemical applications, the fundamentals of wear and corrosion are dealt with on the basis of corresponding applications and the potential for wear and corrosion protection on the coating side is derived and presented. However, surface coatings can also be used to specifically change a number of other properties (electrical and thermal conductivity, physical behaviour, colour, gloss, etc.), which is why these properties are also discussed in the course of this module. Module objectives: **Electroplating:** Students master the essential processes of pre- and post-treatment as well as layer formation. This enables them to select coating systems for specific applications and to optimise processes. **Thermal coating:** Students are familiar with various groups of thermal coating processes that are specifically relevant to industry. They are able to correlate possible coating and substrate materials, coating formation and adhesion mechanisms and the resulting coating properties with the applicable coating processes and thus make a process and material selection for a possible thermal coating process based on the requirements profile for technical surfaces.
Teaching formats	Teaching forms of the module are lectures(V), exercises(Ü) and practical work (P). • V: Electroplating and Thermal Coating (2 LVS)

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	• Ü: Electroplating and Thermal Coating (2 LVS) • P: Electroplating and Thermal Coating (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of the fundamentals of materials technology, surface technology/coating technology
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of the following exams: • 120 minute written exam on Electroplating and Thermal Coating (examination number: 32512) The examination must be taken in the English language.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a students' workload of 150 WH (working hours)
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	231831-012 (Version 05)
Module name	Complex Materials for Manufacturing
Module responsibility	Professorship of Composites and Material Compounds
Content and module objectives	Contents: The increasing complexity of product requirements increasingly calls for the use of modern material solutions. In addition to ceramic and metallic construction materials, composite materials and material composites are becoming increasingly important. As a single material often does not fully meet the required property profile, the development of suitable material combinations and the development of new manufacturing technologies are essential. Complex designed material systems occupy a key position and are of fundamental importance on the growth markets. Tailor-made materials for lightweight construction and high-temperature applications are in demand. To this end, new joining and composite concepts must be developed for a wide variety of material groups. This requires material-specific knowledge and correlation skills as well as the design of manufacturing technologies. In the module, the development and use of metallic, ceramic and glass-like lightweight, high-temperature and composite materials are discussed in particular and the importance of these material groups for the production of customized material solutions is elaborated. Students will first receive an overview of the definitions of terms. Materials science fundamentals with reference to the materials under consideration are explained, and the properties and application potential are discussed. Various reinforcement concepts for composite materials based on fibres and particles are presented and discussed in depth. Aspects of material digitalization and simulation are taught using the example of ceramic matrix composites. Furthermore, the suitable combination of materials to form material composites by means of innovative manufacturing processes is dealt with. In the practical course, students gain an insight into the manufacture and characterization of ceramic and metal-based composites. Module objectives: Students will be able to confidently use the terms metal, ceramic, glass, composite and material composite, explain common manufacturing processes and characterize the properties. In addition, students have demonstrated the necessary expertise to confidently assess the application potential of metallic, ceramic and glass-like lightweight materials and their composite solutions. They will be able to identify challenges in joining dissimilar materials and propose appropriate joining solutions. Likewise, students are able to evaluate and apply manufacturing and testing methods with regard to the opportunities and limitations of these material groups.
Teaching formats	Learning methods of the module are Lecture (V) and practical work (P). • V: Complex Materials for Manufacturing (2 LVS) • P: Complex Materials for Manufacturing (1 LVS) The teaching events will be held in the English language.
Requirements for participation (recommended knowledge and skills)	Fundamentals of Materials Engineering
Module application	---
Requirements for awarding of credit points	The successful passing of the module examination is the precondition for the award of credit points.
Module exam	The module examination consists of: • 120-minute exam on Complex Materials for Manufacturing (examination number: 33319) The examination language is English. On request, in exceptional cases, the

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	examination performance can be provided in German.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a students' workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	231035-005 (Version 03)
Module name	Instrumentation
Module responsibility	Professorship of Sports Equipment and Technology
Content and module objectives	Contents: The module Instrumentation conveys the procedure and the special requirements to measure the human-environment interaction with measuring instruments. The basic approaches for the selection of suitable hardware, software and measurement methodology as well as the design and composition of corresponding measurement chains are taught for different measuring tasks. Module objectives: After successfully completing the module, students will be able to understand and independently apply key principles for selecting sensors and data acquisition systems for measuring physical (especially mechanical) parameters in the context of 'people and production' for specific applications. The special requirements for selecting the components of the measurement chain are known and can be applied to the solution of an individual measurement task. Students are able to select suitable software for data analysis and to summarise the collected data into application-relevant information using adequate methods and to present it in a scientifically correct manner.
Teaching formats	The teaching format of the module are Lectures (V) and practical work (P). • V: Instrumentation (1 LVS) • P: Instrumentation (2 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Instrumentation (Exam number: 32801) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	231733-011 (Version 01)
Module name	Industrial Robotics and Periphery
Module responsibility	Professorship of Assembly and Handling Technology
Content and module objectives	Contents: This module presents current developments in robotics and imparts fundamental knowledge regarding robot systems, end-effectors, and robot peripherals. It introduces the structural design of mechatronic drive systems as a basis for industrial robotics. Current end-effectors are classified, and the kinematic behavior of typical robot structures is derived based on forward and inverse kinematics. Students receive a practical, concise introduction to modern trends in robotics, address key issues regarding the selection and evaluation of industrial robots and robot control architectures, and learn fundamental robot programming methods. A forward-looking focus is placed on the integration of AI agents in robotics. Another key area is the explanation of the functional principles of various end-effectors, covering their structural design and approaches to calculating gripping force. Module objectives Students can contextualize industrial robotics and possess the ability to analyze, classify, and evaluate robot systems, peripherals, and end effectors. Upon completion of the module, students will be able to: • classify gripping tasks, select product-specific end-effectors, and analyze or develop gripper solutions, • classify industrial robot systems and their peripheral equipment, and analyze their structural and functional design, • derive the forward kinematics of serial manipulators and the inverse kinematics of parallel manipulators, • visualize robot models in the Robot Operating System and design basic control architectures, • understand the fundamentals of foundation models in robotics and apply prompt engineering techniques to develop AI agents.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Industrial Robotics and Periphery (2 LVS) • Ü: Industrial Robotics and Periphery (2 LVS) The courses are supplemented by digital learning materials for independent study.The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of Advanced Mathematics I, Engineering Mechanics I, II, and III, and Fundamentals of Computer Science I
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 120-minute exam of Industrial Robotics and Periphery (Exam number: 32313) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).

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Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	232033-012 (Version 01)
Module name	Fundamentals of Hydrogen Technologies
Module responsibility	Professorship of Advanced Powertrains
Content and module objectives	Contents: • Introduction to fuel cell and hydrogen technology • (Energy issues, history, types and applications, hydrogen properties) • Hydrogen technology (Production, storage, overall energy analysis) • Physicochemical principles of fuel cells (Chemical reactions, thermodynamics) • Fuel cell systems (Design, module components, efficiencies) Module objectives: Upon successful completion of the module, students are able to explain and perform calculations regarding the fundamental electrochemical system of a fuel cell, specifically the primary reactions involved, fuel cell types, and their characteristic curves. Students can identify the key properties of hydrogen and recognize the associated hazards. Furthermore, they are able to describe the structure and function of a fuel cell and a fuel cell system.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Fundamentals of Hydrogen Technologies (2 LVS) • Ü: Fundamentals of Hydrogen Technologies (1 LVS) • P: Fundamentals of Hydrogen Technologies (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamentals of Mathematics, Physics, and Thermodynamics
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minute oral exam of Fundamentals of Hydrogen Technologies (Exam number: 33721) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	232033-013 (Version 01)
Module name	Fuel Cells and Fuel Cell Systems
Module responsibility	Professorship of Advanced Powertrains
Content and module objectives	Contents: • Fuel cell derivatives • Fuel cell electrical systems • Fuel cell testing • Fuel cell propulsion systems • Fuel cell vehicles • Hybridization of fuel cell vehicles • Mobile hydrogen storage • Hydrogen production, transport, and refueling (infrastructure) Module objectives: Upon successful completion of the module, students will be able to fully describe the structure, function, and technical characteristics of a fuel cell system and define the requirements for vehicle integration. Furthermore, students will be able to design a hybridization concept for electric vehicles and determine the optimization potential of a fuel cell system within a hybrid vehicle. In addition, they will be able to evaluate and design various hydrogen storage technologies, as well as explain hydrogen production and assess its economic viability.
Teaching formats	Teaching formats of the module are Lectures (V), Exercises (Ü) und Practical work (P). • V: Fuel Cells and Fuel Cell Systems (2 LVS) • Ü: Fuel Cells and Fuel Cell System (1 LVS) • P: Fuel Cells and Fuel Cell Systems (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamentals of Mathematics, Physics, and Thermodynamics
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 30-minute oral exam of Fuel Cells and Fuel Cell Systems (Exam number: 33720) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	231435-016 (Version 01)
Module name	Techno-Economic Analysis of Hydrogen Energy Systems
Module responsibility	Professorship of Technical Thermodynamics
Content and module objectives	Contents: The module provides a comprehensive introduction to techno-economic analysis using hydrogen-based energy systems as a case study, focusing on production (e.g., electrolysis), compression/liquefaction, long-distance transport, storage, regasification, and end-use. Students learn to apply thermodynamic principles, process simulation tools, and established cost calculation methods to real-world hydrogen value chains. The module is complemented by a practical software workshop and a final group project based on a simplified, real-world hydrogen export/import corridor. Module objectives: Upon successful completion of the module, students are able to describe and compare technologies along a value chain, prepare energy and material balances for hydrogen systems, apply established cost estimation techniques, and independently develop a simplified techno-economic study for value chains and clearly present the results.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Techno-Economic Analysis of Hydrogen Energy Systems (2 LVS) • Ü: Techno-Economic Analysis of Hydrogen Energy Systems (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of Technical Thermodynamics I and Heat Transfer
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • Group assignment (3 to 5 students) conducted throughout the semester on the hydrogen compression cycle (length: max. 5 pages per student; duration: 15 weeks), including a presentation (5 minutes per student) and a subsequent oral examination (5 minutes per student) based on the assignment, covering the techno-economic analysis of hydrogen energy systems. The examination may be taken in German or English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	261033-312 (Version 01)
Module name	Life Cycle-oriented Management
Module responsibility	Professorship of BWL III – Management Accounting and Control
Content and module objectives	Contents: The module begins by providing an overview of lifecycle models and concepts. Subsequently, lifecycle-related design tasks associated with the strategic management level and the instruments available for them are presented. The focus is on selected lifecycle-related decision models and methods, such as: • Life Cycle Costing / Total Cost of Ownership • Dynamic investment appraisal for decisions regarding economic viability, useful life, and replacement timing • Flow cost accounting • Key performance indicators and KPI systems • Business model development Module objectives: Students in the module are familiar with lifecycle-related decisions from a business management perspective and are able to explain them; furthermore, they have acquired specific knowledge, particularly regarding the relevant methods for decision preparation.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Life Cycle-oriented Management (2 LVS) • Ü: Life Cycle-oriented Management (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Life Cycle-oriented Management (Exam number: 61420) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	261042-301 (Version 02)
Module name	Sustainability Management
Module responsibility	Professorship of BWL – Corporate Environmental Management and Sustainability
Content and module objectives	Contents: Integrative management skills are essential for today's business operations and decision-making processes. Integrating sustainability aspects is not merely an add-on, but rather represents a different perspective and a systemic conceptualization of management activities. The module covers all key corporate functions, such as sustainable procurement, production, logistics, supply chain management, organization, and marketing. In addition, essential tools and standards are introduced. Alongside theoretical and conceptual work, various examples from different industries are discussed and analyzed. Module objectives: Upon successful completion of the module, students will be able to: • identify the actors, issues, and interrelationships associated with the sustainability activities of functional areas (Knowledge), • explain the interactions and systemic processes involved in sustainability management (Comprehension), • evaluate sustainability concepts within various contexts (Application), • determine sustainability tools and the limitations of sustainability innovations across holistic value chains (Analysis), • assess the prerequisites and conditions for sustainability-oriented strategies, innovations, and tools (Evaluation).
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Sustainability Management (2 LVS) • Ü: Sustainability Management (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	see the course's recommended reading list (chair website, learning platform, or slide deck)
Module application	The module is suitable for degree programs with a business or economics focus, as well as for service teaching.
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 60-minute exam of Sustainability Management (Exam number: 62104) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the summer semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Electives/Soft skills

Module number	261033-310 (Version 01)
Module name	Resource Efficiency from an Economic Perspective
Module responsibility	Professorship of BWL III – Management Accounting and Controlling
Content and module objectives	Contents: The module begins by providing an overview of how resources and resource efficiency are embedded within the field of business administration. Building on discipline-specific concepts of resources and efficiency, it then introduces methods of internal corporate accounting that enable the recording and analysis of resource requirements and consumption, thereby contributing to the assessment and management of resource efficiency. Specific topics include, among others: • Resources and resource efficiency in business administration • Production and cost theory • Cost accounting • Investment appraisal • Selected approaches to cost management Module objectives: Participants in the module acquire knowledge regarding the business perspective on resources and resource efficiency, as well as production and cost theory—including production functions. They are able to apply and evaluate selected methods of cost accounting, cost management, and investment appraisal.
Teaching formats	Teaching formats of the module are Lectures (V) und Exercises (Ü) • V: Resource Efficiency from an Economic Perspective (2 LVS) • Ü: Resource Efficiency from an Economic Perspective (1 LVS) The teaching events are held in English.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module has one examination: • 90-minute exam of Resource Efficiency from an Economic Perspective (Exam number: 61424) The examination will be conducted in English.
Credit points and grades	5 credit points are awarded within the module. The grading of the examination and the generation of the mark is regulated in § 10 of the Examination Regulations.
Module frequency	The module is offered every academic year in the winter semester.
Workload	The module comprises a student workload of 150 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.

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Modul Applied Engineering Project

Module number	230100-860 (Version 03)
Module name	Applied Engineering Project
Module responsibility	Dean of Studies for Advanced Manufacturing, Faculty of Mechanical Engineering
Content and module objectives	Contents: The module focuses on the independent and systematic execution of a practical task in the field of Advanced Manufacturing, applying knowledge previously acquired. The task is typically provided by a regional company (industry partner) and supervised by a professorship associated with the degree program. In addition to addressing the technical aspects of the specific task, students are introduced to methodological and practical challenges and their solutions, while adhering to scientific standards. The task may be completed individually or, preferably, as part of a team. Alongside the project work, a seminar teaches students how to handle experimentally obtained data in a scientifically rigorous manner—covering everything from data acquisition, analysis, and visualization to publication in accordance with current standards. In addition, field trips to regional companies are offered. Module objectives: Students gain insight into regional mechanical engineering companies and their current development needs. They are able to independently familiarize themselves with a company's relevant technological challenges, work in teams to develop user-oriented solutions using scientific methodology, and present these findings both in writing and orally. Furthermore, students are capable of devising a suitable methodology for conducting experiments and presenting the results accurately and appropriately.
Teaching formats	Teaching formats des Moduls sind Projekt, Exkursion und Seminar. • PR: Applied Engineering Project (15 Wochen semesterbegleitend) (2 LVS) • E: Field trips to regional companies (1 LVS) • S: Experimental Data: Collection, Analysis, Presentation, Publication (1 LVS) Consultations with the supervisor may be availed of for support.
Requirements for participation (recommended knowledge and skills)	None
Module application	---
Requirements for awarding of credit points	Successful completion of the exam modules is a prerequisite for the awarding of credit points.
Module exam	The module examination consists of two assessment components. Specifically, the following assessment components must be completed: • Project work (written work; Length: approx. 15 pages per student; completion period: 15 weeks.) (Exam number: I_M_Ad-8130) • 30-minute oral examination on the project work, consisting of a 15-minute presentation followed by a 15-minute discussion. (Exam number: I_M_Ad-8140)
Credit points and grades	10 ECTS credits are earned in this module. The assessment of examination performance and the calculation of the module grade are governed by § 10 of the examination regulations. Examination performance: • Project work, Weight 7 – passing required • Oral examination on the project work, consisting of a presentation followed by a discussion, Weight 3 – passing required
Module frequency	The module is offered in every semester
Workload	The module comprises a student workload of 300 WH (working hours).

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Module duration	In a regular course of studies, the module extends to one semester.

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Modul Master-Arbeit

Module number	230100-960 (Version 03)
Module name	Master Thesis
Module responsibility	Dean of Studies for Advanced Manufacturing, Faculty of Mechanical Engineering
Content and module objectives	Contents: Through the master's thesis, students are expected to apply the knowledge they have acquired to a specific scientific task, thereby demonstrating their research competence. In doing so, they must take into account the prescribed timeframe and available resources. The written thesis describes the research area in general terms to place the task within a broader context, while also presenting the solution and the methodology used to reach it in a concise and scientifically precise manner. The specific task must be selected in consultation with the academic supervisor and be appropriate for the required scope of the thesis. The master's thesis may be conducted either at the university or externally—for example, in industry or at a research institute. However, an external project is only permitted if the student has secured prior agreement for supervision from a faculty member of the Faculty of Mechanical Engineering. This faculty member is also responsible for formally issuing the thesis topic. The Examination Board decides on the appointment of faculty members from other faculties as supervisors. The supervisor is also available for consultation regarding questions and decision-making, as well as to provide support for practical experiments. A concurrent seminar provides instruction on the design and structure of the thesis, the scientifically sound handling of research data, academic writing, and the presentation of research findings. To prepare students—particularly for entry into the German job market—the seminar also covers the fundamentals of preparing application documents in German. Module objectives: Upon successful completion of the module, the students have demonstrated that they are able to: • independently apply the theoretical and application-oriented specialist knowledge acquired during the degree program to a complex task in the field of mechanical engineering, or independently acquire the new knowledge and skills required for the solution, • select suitable research methods, justify that selection, and—where necessary—plan and responsibly conduct the required studies and experiments, • explain their own research results and critically interpret them in relation to the project specifications or the state of the art, • document the research methodology and results appropriately and in accordance with scientific standards, and present them in German.
Teaching formats	The teaching format of the module is Seminar (S). • S: Academic Work and Communication for Engineers (2 contact hours per week) The seminar is offered in German. It may also be conducted as a block course. The master's thesis is to be completed through independent academic work following a briefing on the topic's objectives and requirements. Consultations with the thesis supervisor should be utilized for support.
Requirements for participation (recommended knowledge and skills)	successfully completed module 136004-017 German for Engineers (Mechanical Engineering) (Level B1+) or at least comparable German language proficiency
Module application	---

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Requirements for awarding of credit points	Meeting the admission requirements for the individual examination components and successfully completing the examination modules are requirements for the awarding of credit points. Admission requirements are: • for the Master's thesis examination: modules totaling 75 ECTS credits • for the oral examination (presentation and colloquium on the results of the Master's thesis): modules totaling 90 ECTS credits and a grade of at least "sufficient" for the Master's thesis
Module exam	The module examination consists of two assessment components. Specifically, the following assessment components must be completed: • Master's thesis (Length: approx. 80 pages; completion period: 23 weeks, or 46 weeks for part-time study) (Exam number: I_M_Ad-9110). The examination may be taken in German or English. • 45-minute oral examination (15-minute presentation in German and a 30-minute colloquium in German or English regarding the results of the Master's thesis) (Exam number: I_M_Ad-9120)
Credit points and grades	30 credits are earned in the module. The assessment of examination performance and the calculation of the module grade are governed by § 10 of the examination regulations. Examination performance: • Master Thesis, Weight 7 – passing required • Oral exam (Presentation and defense of the results of the Master Thesis), Weight 3 – passing required
Module frequency	The module is offered in every semester
Workload	The module comprises a student workload of 900 WH (working hours).
Module duration	In a regular course of studies, the module extends to one semester.