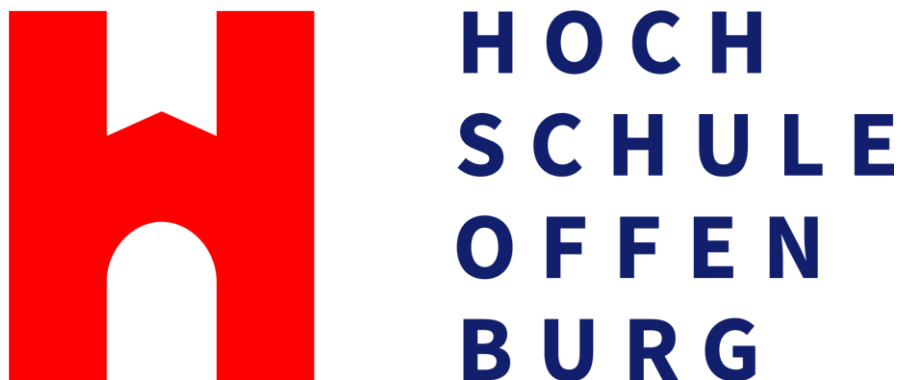


Module Manual

Bachelor MSE-B

**Mechanical Systems
Engineering**

StuPO 20262



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MSE-B 01: Mathematics 1

Module Name	Mathematics 1
Recommended Prerequisites	Basic mathematical knowledge
Teaching Format	Lecture
Learning Objectives	Upon completion of the module, students will have the tools to understand key causal relationships in the applied sciences and to deal with them constructively. Students will have mastered the mathematical terminology, tools, and fundamental approach to problem-solving to the extent that they can transfer and apply them to specific engineering tasks. Students will be able to independently solve real-world problems using the material covered in the lecture.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 67.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Written exam, 90 min.
Module coordinator	Prof. Harald Wiedemann
(Max. participants)	N/A
Recommended semester	MSE-B1
Frequency	Every winter semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course Mathematics 1

Name	Mathematics 1
Type	Lecture
No.	Course number according to StuPO
SWS	6

(Exam format)	N/A
Course Content	The course is structured as follows: • Review of the basics (sets, equations and inequalities, propositional logic) • Vector Algebra and Analytical Geometry • Functions and curves • Sequences and series • Differential Calculus • Integral Calculus
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Papula, L.: Mathematics for Engineers and Natural Scientists, Volume 1, Vieweg, Papula, L. (Vieweg, 2000) • Arens et al: Mathematics, (Spektrum Akademischer Verlag, 2011)

MSE-B 02: Mechanics 1

Module Name	Mechanics 1
Recommended Prerequisites	Preliminary courses in mathematics and physics are beneficial
Teaching Format	Lecture and lab
Learning objectives	Students are able to • confidently apply the concepts of statics • determine the centers of gravity of lines, surfaces, and solids • classify mechanical systems and decompose them into analyzable subsystems • assess the solvability of subsystems • determine bearing forces and section loads • Assess and account for friction flows
Duration	1 semester
SWS	5
Workload	Course: 56.25 h Self-study/group work: 123.75 h Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6

Requirements for awarding credits	Engineering Mechanics 1: K90 (module grade) Experimental and Numerical Mechanics 1: Lab work (ungraded)
Module Coordinator	Prof. Gerhard Kachel
(Max. participants)	N/A
Recommended Semester	MSE-B1
Frequency	Every winter semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course : Engineering Mechanics 1

Name	Engineering Mechanics 1
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Introduction, theorems of statics • Force vectors, vector calculus • Equilibrium at a point • Resultant forces of force systems • Equilibrium of a rigid body • Trusses and systems of rigid bodies • Internal forces • Friction • Center of gravity • Application examples for the respective degree programs
(Course objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Experimental and Numerical Mechanics 1

Name	Experimental and Numerical Mechanics 1
Type	Lab
No.	Course number according to the StuPO
SWS	1 SWS
(Exam format)	N/A

Course Content	The lecture content is reinforced in laboratory sessions, partly with computer support and through experiments.
(Course Objectives) <i>(Acquisition of competencies)</i>	N/A
(Teaching and learning methods)	N/A
(Course language)	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 03: Design 1

Module Name	Design 1
Recommended Prerequisites	Prerequisite courses in mathematics, physics, and programming
Teaching Format	Lecture and lab
Learning Objectives	Students will acquire knowledge in the areas of • Technical documentation and CAD • Load assumptions and stresses in static and dynamic mechanical systems • Strength calculations for mechanical systems according to the FKM guideline and DIN 743 • Design and sizing of bearing systems (rolling bearings and plain bearings) This enables future engineers to make technically sound decisions in their professional lives, regardless of specific applications, based on a solid understanding of technical documentation, design methodology, and strength calculations.
Duration	1 semester
SWS	6

Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Design 1: K90 (module grade) CAD 1 – Lab: PA (ungraded)
Module Coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B1
Frequency	Every winter semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Design 1

Name	Design 1
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Technical Documentation and Standard-Compliant Technical Drawing • Surface specifications, dimensional, form, and positional tolerances • Fundamentals of methodical design and the systematic development process • Basic types of stress in mechanical systems • Design methods/strength analysis methods for mechanical systems according to the FKM guideline and DIN 743 • Fundamentals of shafts/axles, design guidelines, and preliminary sizing • Rolling bearings, bearing concepts, design, and service life calculation • Sliding bearings, bearing concepts, design, and service life calculation • Exercises and assignments during the lecture and for self-study
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Lterature	• FKM Guidelines, RFN-07-20-EN • DIN 743 • Childs, Mechanical Design, Elsevier • Stefano Tornincasa, Technical Drawing for Product Design, Springer • Labisch, Wählich, Technical Drawing: Independent Learning and Effective Practice, Springer Additional reading list will be announced during the course.

Course: CAD 1 - Lab

Name	CAD 1 - Lab
Type	Lab

No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Fundamentals of CAD programs and modeling philosophy • Three-dimensional part creation in a CAD program • Assembly creation from components in a CAD program • Generation of technical drawings for assemblies and components • Reinforcement of lecture content and CAD skills through exercises and assignments
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Childs, Mechanical Design, Elsevier • Stefano Tornincasa, Technical Drawing for Product Design, Springer • Jannik Ludewig, Creo Parametric 10.0 for Beginners: A Concise Guide, Springer • Willis, Dogra, Creo Parametric 12.0: A Power Guide for Beginners and Intermediate Users, CADArtifex Additional reading list will be announced during the course.

MSE-B 04: Digital Science

Module Name	Digital Science
Recommended Prerequisites	Prerequisite courses in mathematics, physics, and programming are recommended
Teaching format	Lecture and lab
Learning objectives	Upon successful completion of the course, students will be familiar with the fundamentals of applied computer science and will be able to

	solve engineering problems using methods and techniques from computer science. In particular, the course lays the groundwork for students to confidently engage with key topics and digitalization in later semesters and to develop solutions.
Duration	1 semester
SWS	5
Workload	Course: 75 h Self-study/group work: 105 h Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Computer Science: Practical Work (Module Grade) Numerical Physics: Lab work (ungraded)
Module coordinator	Prof. Bernd Waltersberger
(Max. participants)	N/A
Recommended Semester	MSE-B1
Frequency	Every winter semester
Applicability	Bachelor's MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Computer Science

Name	Computer Science
Type	Lecture and Lab
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course covers a selection of the following topics: Lecture: – Fundamentals of Computer Science – Information representation, number systems, coding – Algorithms and algorithm design – Fundamentals of software development (flowcharts, programming paradigms, program structure, programming

	languages, scripting languages vs. compiled languages, input and output, functions) Programming Exercises: – Learning and deepening understanding of programming and algorithmic thinking through various program examples – Simple data types, variables, and higher-level data structures (definition, declaration) – Program and control structures (loops, functions, modules) – Documentation, testing, and validating code
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Numerical Physics

Name	Numerical Physics
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The course supports the consolidation of lecture content using computer-aided methods. The practical relevance is established in particular by examining physical problems, e.g. • Error analysis, linear regression, error propagation • Elementary mathematics using computer algebra systems • Simple mechanical or electrical problems, e.g., oblique throw, circuit calculations

(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 05: Language 1

Module Name	Language 1
Recommended Prerequisites	None
Teaching Format	Seminar
Learning objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), students must enroll in elective courses or additional language courses within the Language 1/2/3/4/5 modules. Students learn and deepen their knowledge of the German language in a language course at the Language Center. The language level of the course is determined individually based on the students' existing German language proficiency. Students without prior German language courses start at the A1.1 level.

	Students develop proficiency in using German technical and scientific terminology through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Language Center course: K60+M (module exam) (module grade) Applied Language 1: PA (ungraded)
Module coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B1
Frequency	Every winter semester
Availability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the Language Center

Name	as per the Language Center
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	According to the Language Center

(Course Objectives) <i>(Skill acquisition)</i>	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	as per the Language Center

Course: Applied Language 1

Name	Applied Language 1
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to compensate for differences in students' learning levels • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications
(Course Objectives) <i>(Skill acquisition)</i>	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel

Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.
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MSE-B 05: Electives 1

Module Name	Electives 1
Recommended Prerequisites	None
Teaching Format	Seminar
Learning objectives	When submitting the declaration accompanying the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), students must take courses from the elective area or additional language courses within the Language 1/2/3/4/5 modules. Students explore topics of their own choosing from the elective area or from the Language Center. Upon consultation with the Dean of Studies, courses from ZEF21, Challenge.EU, or other qualified courses (online) may also be taken. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours

(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	As determined by the instructor Elective Applied Language 1: PA (ungraded)
Module coordinator	Prof. Christian Wetzol
(Max. participants)	N/A
Recommended Semester	MSE-B1
Frequency	Every winter semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the elective course list

Name	as per the elective course list
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	as specified by the instructor Elective
(Course objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	German, English, or any other language
(Instructor)	N/A

Reading list	As specified by the instructor Elective area
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Course: Applied Language 1

Name	Applied Language 1
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to compensate for differences in students' learning levels • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications
(Course learning objectives) (Skill acquisition¹)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective fundamental engineering disciplines.

MSE-B 06: Mathematics 2

Module Name	Mathematics 2
Recommended Prerequisites	Module Mathematics 1
Teaching Format	Lecture
Learning Objectives	Upon completion of the module, students will have the tools to understand key relationships in the applied sciences and to deal with them constructively. Students will have mastered the mathematical terminology, tools, and fundamental approach to problem-solving to the extent that they can transfer and apply them to specific engineering tasks. Students will be able to independently solve real-world problems using the material covered in the lecture. The material of the Mathematics 1 module is reinforced through the deliberate selection of examples.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	K90
Module coordinator	Prof. Harald Wiedemann
(Max. participants)	N/A
Recommended Semester	MSE-B2
Frequency	Every summer semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course Mathematics 2

Name	Mathematics 2
Type	Lecture
No.	Course number according to StuPO

SWS	6 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Error analysis, error propagation, and linear regression • Complex numbers • Matrix calculus • Ordinary differential equations, including Laplace transforms • Differential and integral calculus for functions of several variables
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Bibliography	See the reading list for the Mathematics 1 course. The current reading list will be announced during the course.

MSE-B 07: Mechanics 2

Module Name	Mechanics 2
Recommended Prerequisites	Mathematics 1, Mechanics 1, Digital Science
Teaching Format	Lecture and Lab
Learning Objectives	Students acquire in-depth knowledge of the computational strength assessment of components, particularly in technical applications. They will understand the fundamental methodology as well as the basic mechanical equations and input parameters relevant to strength analysis. This will enable them to independently plan and perform a computational strength analysis, to represent fundamental structural elements in an abstract manner, and to identify critical points regarding component failure. This equips future engineers to make well-founded decisions regarding design and material selection in their professional lives, based on solid mechanical principles and independent of specific applications.
Duration	1 semester

SWS	5 SWS
Workload	Course: 56.25 hours Self-study/group work: 123.75 h Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Engineering Mechanics 2: K90 (module grade) Experimental and Numerical Mechanics 2: Lab work (ungraded)
Module Coordinator	Prof. Gerhard Kachel
(Max. participants)	N/A
Recommended Semester	MSE-B2
Frequency	Every summer semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Engineering Mechanics 2

Name	Engineering Mechanics 2
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course covers the following topics: • Learning the basic methodology, the fundamental mechanical equations (equilibrium condition, kinematic relationship, law of elasticity), and the basic quantities • Learning the fundamentals of strength analysis under multi-axial loading: stress and strain states and the law of elasticity • Application of the fundamentals to specific structural elements: tension and compression members, beam bending, torsion members • Applying the fundamentals to more complex loading situations by superimposing simple loading cases • Assessing application limits and uncertainties in computational strength analysis • Application examples for the respective degree programs
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Experimental and Numerical Mechanics 2

Name	Experimental and Numerical Mechanics 2
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The lecture content is reinforced in labs, partly with computer support and through experiments.
(Course Objectives) (Acquisition of competencies)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 08: Materials

Module Name	Materials
Recommended Prerequisites	None
Teaching Format	Lecture and lab
Learning Objectives	Upon completion of the module, students will be able to: • Explain the structure-property relationships of materials, • distinguish and evaluate major classes of materials, • classify microstructures, phase diagrams, and heat treatment of metallic materials, • describe and evaluate material testing and damage mechanisms, • select materials for biomechanical and mechanical engineering applications.

Duration	1 semester
SWS	6 SWS
Workload	Course: 67.5 hours Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Materials Engineering: K90 (module grade) Materials Engineering – Lab: Lab Work (ungraded)
Module Coordinator	Prof. Dirk Velten
(Max. participants)	N/A
Recommended Semester	MSE-B2
Frequency	Every summer semester
Applicability	Bachelor's MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Materials Engineering

Name	Materials Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Fundamentals of Materials Science ○ Bonds in solids ○ Classification of materials ○ Structure and Properties of Materials • Metallic materials (focus) ○ Crystal Structure and Lattice Defects ○ Alloys and phase diagrams ○ Iron-carbon diagram ○ Heat treatment of metals ○ Mechanical Properties and Materials Testing • Non-metallic materials ○ Ceramic materials: structure, properties, and applications ○ Polymers: Structure, Processing, and Technical Applications ○ Composite materials: Matrix and fiber materials

	• Material Selection and Applications in Biomechanics and Mechanical Engineering ○ Criteria for material selection ○ Influence of environmental conditions and stress ○ Sustainability and recycling of materials • Material testing and damage analysis ○ Destructive and non-destructive testing methods ○ Fracture mechanics and types of damage ○ Corrosion and wear behavior of materials
(Course Objectives) (Competency acquisition)	N/A
Teaching and learning methods)	N/A
(Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Materials Engineering - Lab

Name	Materials Engineering Lab
Type	Lab
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Microstructural Analysis of Metallic Materials ○ Objective: Examination of the microstructure of metallic materials using a light microscope ○ Methods: Section preparation, etching, microscopy ○ Relation to theory: Microstructure, phase diagrams, heat treatment • Mechanical testing of materials ○ Objective: Determination of mechanical properties (hardness, tensile strength, elongation at break) ○ Methods: e.g., tensile test, hardness test, notched impact test ○ Relation to theory: Elasticity, plasticity, fracture mechanics • Heat treatment of steels ○ Objective: Influence of annealing, hardening, and tempering on microstructure and hardness ○ Methods: e.g., temperature control, hardness measurement, microstructural analysis ○ Relation to theory: iron-carbon phase diagram, phase transformations • Non-destructive testing (NDT) ○ Objective: Detection of defects in materials without causing damage ○ Methods: e.g., ultrasonic testing, radiographic testing, magnetic particle testing ○ Theoretical background: Material defects, testing methods, quality control
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 09: Thermodynamics

Module Name	Thermodynamics	
Recommended Prerequisites	Mathematics, particularly differential and integral calculus; Fundamentals of classical mechanics; General physics, in particular the fundamentals of physical quantities, the International System of Units, and knowledge of fundamental physical laws and principles; Basic knowledge of programming in Python is also recommended, particularly for performing calculations and visualizing data.	
Teaching format	Lecture	
Learning Objectives	Upon completion of the module, students will have a solid understanding of the fundamental terms and concepts of thermodynamics. They will be able to define appropriate systems depending on the specific problem and to formulate the laws of conservation precisely. In addition, students will be familiar with various model substances (e.g., ideal gas, incompressible liquid, vapor-liquid equilibrium) and will be able to apply both thermal and caloric equations of state to them. They will be familiar with the interpretation and use of phase diagrams and will understand the significance of the second law of thermodynamics. They can apply the quantity of entropy in calculations and place it in its physical context. Furthermore, students are able to systematically analyze thermodynamic cyclic processes (such as gas and vapor processes) and calculate the energy flows within the process and its components. They understand approaches to describing mixtures of substances and can independently familiarize themselves with advanced areas of phenomenological thermodynamics, such as multiphase thermodynamics or chemical thermodynamics.	
Duration	1 semester	
SWS	6	
Workload	Course:	67.5 h
	Self-study/group work:	112.5 hours
	Total workload:	180 hours
(Credits and Grades)	N/A	
ECTS credits	6	
Requirements for awarding credits	K120	
Module coordinator	Prof. Peter Treffinger	
(Max. participants)	N/A	
Recommended Semester	MSE-B2	

Frequency	Every summer semester
Applicability	Bachelor's in MSE – Foundational Studies
Methodology	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Thermodynamics

Name	Thermodynamics
Type	Lecture
No.	Course number according to the StuPO
SWS	6 SWS
Exam format	K120
Course Content	The course is structured as follows: • Introduction ○ Applications, distinction between phenomenological and statistical thermodynamics using selected examples ○ Fundamentals and terminology (systems, state variables, processes) • The two laws of thermodynamics ○ First Law: Conservation of Energy ○ Second Law: Entropy and Irreversibility ○ Application of the laws to closed and open systems • Description of pure substances and mixtures ○ Ideal gas and real gas, incompressible liquid ○ Vapor-liquid equilibrium ○ Fundamentals of thermodynamics of mixtures (inert gas-vapor mixture, humid air) • Cyclic processes ○ Gas processes (including Otto, Diesel, and Brayton cycles) ○ Vapor processes (including Clausius-Rankine cycle, cold vapor process) • Outlook and in-depth analysis using selected examples
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Bibliography	• Baehr, Hans Dieter; Kabelac, Stephan: <i>Thermodynamics</i>. Berlin: Springer, 2016, • Labuhn, Dirk; Romberg, Oliver: <i>Don't Panic About Thermodynamics!: Success and Fun in the Classic "Dry-as-Dust Subject" of Engineering Studies</i>. Wiesbaden: Springer Fachmedien, 2012 • Treffinger, Peter: Lecture Materials and Exercise Collection on Thermodynamics, Offenburg University of Applied Sciences, 2025

MSE-B 10: Language 2

Module Name	Language 2
Recommended Prerequisites	None
Teaching Format	Seminar
Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country [where German is the language of instruction and learning]), students must enroll in elective courses or additional language courses within the Language 1/2/3/4/5 modules. Students learn and deepen their knowledge of the German language in a language course offered by the Language Center. The language level of the course is determined individually based on the students' existing German language proficiency. Students without prior German language courses are placed at the A1.2 level. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Language Center course: K60+M (module exam) (module grade) Applied Language 2: PA (ungraded)
Course Coordinator	Prof. Christian Wetzels
(Max. participants)	N/A
Recommended Semester	MSE-B2

Frequency	Every summer semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the Language Center

Name	as per the Language Center
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	According to the Language Center
(Course Objectives) (Skill acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading list	as per the Language Center

Course: Applied Language 2

Name	Applied Language 2
Type	Seminar
No.	Course number according to StuPO

SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Introduction to academic work and the writing of technical reports and documentation
(Course learning objectives) (Skill acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 10: Electives 2

Module Name	Electives 2
Recommended Prerequisites	None
Teaching Format	Seminar
Learning objectives	When submitting the declaration accompanying the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If

	German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), students must take courses from the elective area or additional language courses within the Language 1/2/3/4/5 modules. Students explore topics of their own choosing from the elective area or from the Language Center. Upon consultation with the Dean of Studies, courses from ZEF21, Challenge.EU, or other qualified courses (online) may also be taken. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	2 semesters
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	As determined by the instructor Elective Applied Language 2: PA (ungraded)
Module coordinator	Prof. Christian Wetzol
(Max. participants)	N/A
Recommended Semester	MSE-B2
Frequency	Every summer semester
Applicability	Bachelor MSE - Introductory Phase
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the elective course list

Name	as per the elective course list
Type	Seminar
No.	Course number according to StuPO

SWS	4 SWS
(Exam format)	N/A
Course Content	as specified by the instructor Elective
(Course objectives) <i>(Skills acquired)</i>	N/A
(Teaching and learning methods)	N/A
Course language	German, English, or any other language
(Instructor)	N/A
Reading list	As specified by the instructor Elective area

Course: Applied Language 2

Name	Applied Language 2
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the aid of translation programs and AI applications • Introduction to academic work and the writing of technical reports and documentation
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 11: Robotics and Manufacturing

Module Name	Robotics and Manufacturing
Recommended Prerequisites	Mechanics 1/2, Design 1
Teaching Format	Lectures and laboratory work
Learning Objectives	Upon completion of this module, students will be able to:

	- Understanding the basic principles of mobile, collaborative, and industrial robotics, including their topologies and sensor integration - Applying forward and inverse kinematics to analyze and model robotic systems - Identifying the basic manufacturing processes according to the German DIN 8580 standard in industrial applications and evaluating their properties and suitability for different products.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Robotics and Manufacturing: K90 (module exam), (module grade) Robotics Lab: Practical Work (LA) (ungraded)
Module Coordinator	Prof. Marco Schneider
(Max. participants)	N/A
Recommended Semester	MSE-B3
Frequency	Every winter semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	N/A

Course: Robotics

Name	Robotics
Type	Lectures
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A

Course Content	The lectures introduce the fundamental principles as well as current research areas of mobile, collaborative, and industrial robotics. To provide a comprehensive overview of the challenges in modern cobotics, the course covers the basics and extends them to state-of-the-art applications. The core topics include, but are not limited to: • Definition and basics of collaborative and industrial robotics, • Forward and inverse kinematics, • Approaches to system modeling, • Topology, joints, motors, and transmission technology • Sensor technology and integration, • Positioning and repeatability accuracy, • Force control and advanced control strategies, • Current trends and emerging research topics in robotics
(Course learning objectives)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
References	• Siciliano, B., Khatib, O., & Kröger, T. (Eds.). (2008). <i>Springer Handbook of Robotics</i> (Vol. 200, p. 1). Berlin: Springer. • Kajita, S., Hirukawa, H., Harada, K., & Yokoi, K. (2014). Kinematics. In <i>Introduction to humanoid robotics</i> (pp. 19–67). Berlin, Heidelberg: Springer Berlin Heidelberg.

Course: Robotics Lab

Name	Robotics Lab
Type	Laboratory work
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	Practical application of the theoretical concepts introduced in the lectures. The laboratory work involves hands-on experiments and project-based tasks using modern robotic systems or simulation software. Core aspects include: • Familiarization with the operation and programming of industrial and/or collaborative robots • Practical implementation of kinematic models and trajectory planning • Verification of simulation models through real-world testing
(Course Objectives) (Skills acquire)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Laboratory instructions for the individual experiments and tasks

Course: Manufacturing Processes

Name	Manufacturing Processes
Type	Lectures
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The lectures follow the German DIN 8580 standard and cover the following aspects of manufacturing processes: • casting and molding processes, • forming and bending processes, • cutting processes, • joining and coating processes, • additive manufacturing.
(Course Objectives)	Students should acquire fundamental knowledge of manufacturing processes in accordance with DIN 8580 as applied in industry. They should be able to identify, evaluate, and select manufacturing processes for different products.
(Teaching and learning methods)	Lectures with examples and interactive exercises
Course language	English
(Instructor)	Prof. Dr.-Ing. Marco Schneider
References	• <i>Kalpakjian, S.; Schmid, S.: Manufacturing Engineering and Technology. Pearson, 2022.</i>

MSE-B 12: Mechatronics

Module Name	Mechatronics
Recommended Prerequisites	Mathematics 1/2
Teaching Format	Lecture and Lab
Learning Objectives	Upon completion of the module, students will be able to... – identify the basic concepts of electrical engineering and mechatronics and apply them correctly in context,

	– calculate direct-current and alternating-current circuits as well as magnetic circuits, – calculate power in DC and AC circuits as well as in three-phase systems, – explain the occurrence of forces and energies in electric and magnetic fields and calculate them for simple configurations, – recognize analogies between electric current fields and electric fields in non-conductors as well as magnetic fields – understand and explain the functioning of important electrical equipment and circuits, – Model electromechanical and mechatronic systems in an application-oriented manner and evaluate them mathematically (numerically or via simulation, as appropriate).
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	K90 (module grade)
Module coordinator	Prof. Grit Köhler
(Max. participants)	N/A
Recommended semester	MSE-B3
Frequency	Every winter semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Electrical Engineering

Name	Electrical Engineering
Type	Course
No.	Course number according to StuPO
SWS	6 SWS
(Exam format)	N/A
Course Content	The course covers selected chapters from the following subject areas: • Basic concepts of electronics electric charge, electric current, electric voltage, electric potential, electric resistance, electric power, electric energy • Direct current circuits Networks of linear passive and active two-port elements, Kirchhoff's laws, circuit analysis (branch current analysis, loop current analysis, node voltage analysis, superposition method, two-port theory), power conversion in circuits, power matching • The electric field Concept of a field (including source and vortex fields, homogeneous and inhomogeneous fields), electric field in conductors and non-conductors (electrostatic field and time-varying electric field), Displacement current and displacement current density, electric field strength, displacement current, electric influence, Faraday's cage, displacement and orientation polarization, capacitance and capacitors, series and parallel connection of capacitors, energy and force effects in the electric field • The magnetic field Magnetic flux, magnetic induction, magnetic field strength, material effects (especially ferromagnetism), the law of magnetic flux, magnetic circuits and their calculation, analogies between the electric current field and the magnetic circuit, Analogies between electric and magnetic fields, static and dynamic induction (Lorentz force), electromagnetic fields, inductance and coils, self-inductance and mutual inductance, series and parallel connection of coils, energy and force effects in the magnetic field • The Alternating Current Circuit Generation of alternating voltages, alternating quantities and their characteristic values, power in alternating current circuits, sinusoidal currents and voltages across resistors, coils and capacitors, as well as simple circuits in, e.g., oscillating circuits and filters; connection of AC circuits to three-phase systems in star and delta configurations; power in symmetrical and asymmetrical three-phase systems; basic principles of operation of electrical equipment (transformers, motors, and generators) • Be able to classify, model, calculate, and, if necessary, simulate electromechanical and mechatronic systems. • Application examples for the respective degree programs
(Course learning objectives) (Competency acquisition)	N/A

(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Heimann, Albert, Ortmaier, Rissing, Mechatronics: Components – Methods – Examples, Hanser, 2016 • Hering, Steinhart, Handbook of Mechatronics, Hanser • R. Isermann: Mechatronic Systems, Springer The current reading list will be announced during the course.

MSE-B 13: Mechanics 3

Module Name	Mechanics 3
Recommended Prerequisites	Mechanics 1, Mathematics 1/2
Teaching format	Lecture and lab
Learning Objectives	Students acquire in-depth knowledge in the field of theoretical analysis of dynamic technical mechanisms. They learn fundamental methods for the analysis and synthesis of dynamic mechanical systems, particularly in mechanical engineering. This enables them to identify components relevant to dynamic behavior in given technical designs and to abstract them into models. This enables future engineers to make technically sound decisions in their professional lives, independent of specific applications, based on a solid understanding of the fundamentals of mechanics.
Duration	1 semester
SWS	5
Workload	Course: 56.25 h Self-study/group work: 123.75 h Workload: 180 hours
(Credits and Grades)	<i>May be omitted</i>
ECTS credits	6
Requirements for awarding credits	Engineering Mechanics 3: K90 (module grade) Experimental and Numerical Mechanics 3: Lab work (ungraded)
Module Coordinator	Prof. Bernd Waltersberger
(Max. participants)	<i>Optional:</i> Specify the number of participants

Recommended semester	MSE-B3
Frequency	Every winter semester
Availability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Engineering Mechanics 3

Name	Engineering Mechanics 3
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Students will be able, in particular, to represent simple mechanical systems as abstract mechanical-mathematical models and to assess the limits of reasonable model assumptions. • Reasonably assess the limits of application of mass-point models, describe and analyze the motion of mass points. • Appropriately apply abstract mechanical concepts such as work, energy, power, momentum, angular momentum, and instantaneous poles to describe real technical systems. • Describe the planar motion of bodies under the influence of forces and moments using practical, simplified models. • Identify and quantitatively describe simple oscillating technical systems. • Assess the common approaches to dealing with complex spatial mechanisms (gyroscopes, multi-body systems) qualitatively and, within limits, quantitatively in terms of their significance for practical development work. • Students can analyze simple mechanical systems in the exercises • Application examples for the respective degree programs
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading list	The current reading list will be announced during the course. Recommended reading: Gross, Hauger, Schnell, Technical Mechanics 3, Springer

Course: Experimental and Numerical Mechanics 3

Name	Experimental and Numerical Mechanics 3
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The lecture content is reinforced in laboratory sessions, partly with computer support and through experiments.
(Course Objectives) (Acquisition of competencies)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course. Recommendation: Gross, Hauger, Schnell, Technical Mechanics 3, Springer

MSE-B 14: Modeling and Simulation (CAE)

Module Name	Modeling and Simulation (CAE)
Recommended Prerequisites	Mechanics 1/2, Mathematics 1/2, Design 1
Teaching Format	Lecture and Lab
Learning Objectives	Students acquire in-depth knowledge in the field of computer-aided development and analysis of primarily mechanical systems in mechanical engineering and biomechanics. Building on the

	fundamental knowledge they have acquired, they learn advanced methods of computer-aided product development. Students will be able to contribute to the analysis of mechanical problems using computer-aided methods, particularly with regard to dynamic and biomechanical systems. They will understand the capabilities and limitations of simulation methods. By applying the fundamentals of modeling, strength of materials, dynamics, and machine elements, they will be able to plausibly analyze and interpret the results obtained from computational models and simulations. This enables students to apply computer-aided development methods (for the optimal selection of materials, processes, and machine elements) in a targeted manner and to sensibly assess the capabilities and benefits of analysis tools within the development process. In addition, students master the typical application fundamentals of commercially available CAE systems. This enables future engineers to make technically sound decisions in their professional lives, independent of specific CAE applications, based on a solid knowledge of the fundamental working techniques in the field of computer-aided development methods. Furthermore, this significantly facilitates their transition to company-specific software applications.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	CAE: Practical work (weighting of module grade: 2/3) Basic FEM: Practical work (weighting of module grade: 1/3)
Module Coordinator	Prof. Bernd Waltersberger
(Max. number of participants)	N/A
Recommended Semester	MSE-B3
Frequency	Every winter semester
Applicability	Bachelor's in MSE - Advanced Studies
(Methodology)	N/A
(Other notes, information)	<i>Not applicable</i>

Course: CAE

Name	CAE
Type	Lecture and Lab
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course covers selected topics from • Classification of the terms CAD, CAE, CAM, FEM, MKS, CFD, and PDM within the development process. • Selection of fundamental cross-application possibilities of advanced computer-aided development techniques • Fundamental information technology and, in particular, the mathematical background of computer-aided development tools. • The basic approach in the modeling process, from the physical to the mathematical model of a mechanical structure, with a focus on machine dynamics • Cross-application basic capabilities for computer-aided kinematic and dynamic analysis of mechanisms derived from geometric models (generally elastic multi-body systems). • Across various applications, the fundamental possibilities for computer-aided analysis of mechanical engineering systems, and in particular machine dynamics systems, with regard to loading, stress, stability, and dynamic behavior. • Computer-aided development methods are explored in depth through computer exercises using commercially available CAE software. • Application examples for the respective degree programs
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A

Reading	The current reading list will be announced during the course.
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Course: Basic FEM

Name	Basic FEM
Type	Lecture and Lab
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Theoretical foundations of the FEM • Calculation examples from the fields of elastostatics, vibration analysis, and stability theory • Application examples for the respective degree programs
(Course objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 15: Language 3

Module Name	Language 3
Recommended Prerequisites	None
Teaching Format	Seminar
Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If If students have German language proficiency at the B2 level (as evidenced by German being their native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), they must take courses from the elective area or additional language courses in the Language 1/2/3/4/5 modules. Students learn and deepen their knowledge of the German language in a language course at the Language Center. The language level of the course is determined individually based on the students' existing German language proficiency. Students without prior German language courses are placed at the A2.1 level. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Language Center course: K60+M (module exam) (module grade) Applied Language 3: PA (ungraded)
Module coordinator	Prof. Christian Wetzol
(Max. participants)	N/A

Recommended Semester	MSE-B3
Frequency	Every winter semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the Language Center

Name	as per the Language Center
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	According to the Language Center
(Course Objectives) (Skill acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading list	as per the Language Center

Course: Applied Language 3

Name	Applied Language 3
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Assigning individualized German/English practice exercises to continue effectively addressing the heterogeneity in students' learning levels. • Development and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 15: Electives 3

Module Name	Electives 3
Recommended Prerequisites	None

Teaching Format	Seminar
Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country [where German is the language of instruction and learning]), students must take courses from the elective area or additional language courses within the Language 1/2/3/4/5 modules. Students explore topics of their own choosing from the elective area or from the Language Center. Upon consultation with the Dean of Studies, courses from ZEF21, Challenge.EU, or other qualified courses (online) may also be taken. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	2 semesters
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	As determined by the instructor Elective Applied Language 3: PA (ungraded)
Module coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B3
Frequency	Every winter semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	N/A

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Course according to the elective course list

Name	as per the elective course list
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	as specified by the instructor Elective
(Course objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	German, English, or any other language
(Instructor)	N/A
Reading list	As specified by the instructor Elective area

Course: Applied Language 3

Name	Applied Language 3
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective fundamental engineering disciplines.

MSE-B 16: Systems Engineering

Module Name	Systems Engineering
Recommended Prerequisites	Mechanics 1/2/3, Digital Science, Mechatronics, Design 1
Teaching Format	Lecture and Lab

Learning Objectives	Students will learn the fundamentals of methodical system design according to VDI and gain an overview of the following topics: - VDI Guidelines 2220 and subsequent versions, and VDI/VDE 2206 on the methodical development of mechatronic systems - Fundamentals of the systems engineering process and the application of the systems engineering process to the development of complex mechatronic systems - Differences and similarities between the VDI guidelines and systems engineering - Fundamentals of Model-Based Systems Engineering (MBSE) - Software application of the MBSE methodology and system simulation for the validation of complex, general mechatronic system designs Students will be able to systematically and methodically design complex mechatronic systems, validate them through simulation, and evaluate the results.
Duration	1 semester
SWS	4
Workload	Course: 67.5 hours Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Systems Engineering: K90 (Module Exam) (Module Grade) Systems Engineering – Lab: PA (ungraded)
Module Coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B4
Frequency	Every summer semester
Applicability	Bachelor's in MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Systems Engineering

Name	Systems Engineering
Type	Lecture

No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Development methodology for mechatronic systems according to VDI: System concept and definitions, methods, development project workflow • Development methodology of systems engineering and comparison with VDI • Simulation methodology for verifying and validating system requirements at different levels of complex, general mechatronic systems • Methodology and approach of Model-Based Systems Engineering (MBSE) and comparison with the standard, document-centric methodology • Application of MBSE and the SysML language to examples and exercises • Exercises in the course
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	Christian Wetzel
Literature	• VDI 2220 to 2205 • VDI/VDE 2206 • ISO/IES/IEEE 15288 • NASA Systems Engineering Handbook, NASA SP-2016-6105 Rev2 • Systems Engineering For Dummies, ® IBM Limited Edition, Wiley • Birgit Vogel-Heuser, System Engineering with SysML, de Gruyter • Heimann, Albert, Ortmaier, Rissing, Mechatronics: Components – Methods – Examples, Hanser, 2016

Course: Systems Engineering - Lab

Name	Systems Engineering – Lab
Type	Laboratory
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The lab is structured as follows: • Application of MBSE and SysML to exercises and assignments • Use of FOSS (Free and Open-Source Software), e.g., Gaphor, Capella, OpenMBEE, ...) • “Virtual Mechatronic System”: Modeling, system modeling, and simulation (Modelica/OpenModelica, Python, and other programs) • Application and simulation of general mechatronic systems • “Real Mechatronic System”: Introduction to embedded systems (Arduino), control, regulation, and operation of drive systems, application to a real-world model
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	Christian Wetzel
Literature	• VDI 2220 to 2205 • VDI/VDE 2206 • ISO/IES/IEEE 15288 • NASA Systems Engineering Handbook, NASA SP-2016-6105 Rev2 • Systems Engineering For Dummies, ® IBM Limited Edition, Wiley • Birgit Vogel-Heuser, System Engineering with SysML, de Gruyter • Heimann, Albert, Ortmaier, Rissing, Mechatronics: Components – Methods – Examples, Hanser, 2016 • https://gaphor.org/ • https://openmodelica.org/ • https://modelica.org/

MSE-B 17: Fluid Engineering and Heat Transfer

Module Name	Fluid Engineering and Heat Transfer
Recommended Prerequisites	Mathematics 1/2, Thermodynamics

Teaching Format	Lecture
Learning Objectives	Upon completion of the module, students will be able to: • calculate the forces exerted by stationary fluids, • solve one-dimensional flow problems within the framework of streamline theory using Bernoulli's equation • solve velocity and pressure changes in a gravitational field by combining hydrostatics, the continuity equation, and Bernoulli's equation • analyze and calculate pressure losses during flow through pipes, channels, machines, and entire systems • analyze and calculate drag forces in the flow around objects such as motor vehicles, aircraft, and buildings • Gain an understanding of the behavior of compressible flow processes in subsonic and supersonic flows • Understand heat transfer mechanisms • Calculate heat transfer processes involving different transport mechanisms • Independently apply the methods covered in the lecture and design heat exchangers
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	<i>May be omitted</i>
ECTS credits	6
Requirements for awarding credits	K120 (Module Grade)
Module coordinator	Prof. Jörg Ettrich
(Max. participants)	N/A
Recommended semester	MSE-B4
Frequency	Every summer semester
Applicability	Bachelor's in MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Fluid Engineering

Name	Fluid Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Fundamentals: Properties of fluids, molecular structure, material data, Newtonian and non-Newtonian media • Hydrostatics and Aerostatics: Pressure distribution in gravitational and centrifugal fields, forces acting on container walls, Archimedes' buoyancy • Frictionless flows: Streamline theory, Bernoulli's equation, vortex flows, pressure concepts and their measurement, outflows from containers, laminar flows, potential flows, and wing theory • Friction-laden flows: Influence of friction, characteristic numbers, laminar and turbulent flows, Navier-Stokes equations, pressure drop in flowing pipes, impulse theorem, boundary layer theory • Pressure loss and flow resistance • Energy equation, pressure loss in components with flow through them, bends, nozzles, diffusers, drag around bodies, vehicles, airfoils, buildings • Gas dynamics: Flow of compressible media, Laval nozzle, vertical compression shock
(Course objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	<i>Optional:</i> Name of the course instructor
Reading	The current reading list will be announced during the course.

Course: Heat Transfer

Name	Heat Transfer
Type	Lecture

No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	• Introduction to heat transfer using well-known examples from thermodynamics (heat pump/refrigeration machine, energy balance, efficiency and coefficient of performance, heat exchanger) • Fundamental mechanisms of heat transfer • Conduction—or heat transfer in stationary systems: Fourier's equation for heat transfer, application of steady-state conduction to different geometries • Transient heat conduction (introduction to the methodology of dimensionless parameters and similarity theory, Fo and Bi) • Heat convection—or heat transfer in moving systems • Forced convection and its kinetic approach to heat transfer (Numbers Nu, Re, Pr, Nusselt theory, heat transfer coefficients for various applications) • Free convection and its dimensionless parameters (Grashof) • Thermal radiation—or heat transport via electromagnetic radiation • Fundamental law of temperature radiation, Stefan-Boltzmann law, and Lambert's laws, radiative exchange
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	<i>Optional:</i> Name of the course instructor
Reading list	The current reading list will be announced during the course.

MSE-B 18: Mechanics 4

Module Name	Mechanics 4
Recommended Prerequisites	Mechanics 1/2/3, Mathematics 1/2
Teaching Format	Lecture and lab
Learning Objectives	Students acquire in-depth knowledge in the field of theoretical analysis of three-dimensional, dynamic technical mechanisms. They become

	familiar with advanced methods for the analysis and synthesis of dynamic mechanical systems, particularly in mechanical engineering and mechatronics. This enables them to identify components relevant to dynamic behavior in given technical designs and to abstract them into models. This enables future engineers to make technically sound decisions in their professional lives, independent of specific applications, based on a solid understanding of the fundamentals of mechanics.
Duration	1 semester
SWS	5
Workload	Course: 56.25 h Self-study/group work: 123.75 h Workload: 180 hours
(Credits and Grades)	<i>May be omitted</i>
ECTS credits	6
Requirements for awarding credits	Engineering Mechanics 4: K90 (module grade) Experimental and Numerical Mechanics 4: Lab work (ungraded)
Module Coordinator	Prof. Bernd Waltersberger
(Max. participants)	<i>Optional:</i> Specify the number of participants
Recommended semester	MSE-B4
Frequency	Every summer semester
Availability	Bachelor MSE-B - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Engineering Mechanics 4

Name	Engineering Mechanics 4
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: - Students will be able to represent more complex and three-dimensional mechanical engineering systems as abstract mechanical-mathematical models and assess the limits of reasonable model assumptions. - Reasonably assess the limits of application of analytical models in mechanics to describe and analyze the motion of systems of mass points, rigid bodies, and simple continuum structures.

	• Appropriately apply concepts such as work, energy, power, momentum, and angular momentum to describe real-world technical systems. • Describe the general, three-dimensional motion of bodies under the action of forces and moments using practical, simplified models. This involves the application of Lagrange's equations, d'Alembert's principle in its Lagrangian form, and Euler's equations of motion. • Identify and quantitatively describe more complex and multidimensional technical systems capable of oscillation. • Students are able to analyze more complex and three-dimensional mechanical systems in the exercises. • Students can describe simple continuous systems in terms of their dynamics. • Application examples for the respective degree programs
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course. Recommended reading: Gross, Hauger, Schnell, Technical Mechanics 3, Springer; Hibbeler, Technical Mechanics 3: Dynamics, Pearson

Course: Experimental and Numerical Mechanics 4

Name	Experimental and Numerical Mechanics 4
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The lecture content is reinforced in laboratory sessions, partly with computer support and through experiments.
(Course Objectives) (Acquisition of competencies)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course. Recommended reading: Gross, Hauger, Schnell, Technical Mechanics 3, Springer; Hibbeler, Technical Mechanics 3: Dynamics, Pearson

MSE-B 19: Design 2

Module Name	Design 2
Recommended Prerequisites	Mathematics 1/2, Design 1, Mechanics 1/2/3
Teaching Format	Lecture and lab
Learning Objectives	Students will acquire knowledge in the following areas In-depth load assumptions and stresses in static and dynamic mechanical systems

	- Advanced design and sizing of bearing systems (rolling bearings and plain bearings) - Design and sizing of technical springs and elastic structural elements - Design and sizing of fastening and motion screws - Overview of design elements: shaft-hub connections, gear teeth, and gearboxes This enables future engineers to make technically sound decisions in their professional lives, regardless of specific applications, based on a solid understanding of structural elements, design methodology, and strength calculations.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Design 2: K90 (module grade) CAD 2 – Lab: PA (ungraded)
Module Coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B4
Frequency	Every summer semester
Applicability	Bachelor's in MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Design 2

Name	Design 2
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Static and dynamic load assumptions • Technical springs and elastic structural elements (e.g., couplings) • Fastening screws • Movement screws • Overview of shaft-hub connections, gear teeth, and gearboxes • In-depth look at rolling bearings, bearing arrangements, design, and service life calculation • In-depth study of plain bearings, bearing concepts, design, and service life calculation • Exercises and assignments during the lecture and for self-study
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• FKM Guidelines, RFN-07-20-EN • DIN 743 • Childs, Mechanical Design, Elsevier • DIN 2090 and subsequent standards for springs • DIN EN 13906 and subsequent standards for springs • VDI 2230 and subsequent standards for bolted joints A further reading list will be announced during the course.

Course: CAD 2 - Lab

Name	CAD 2 - Lab
Type	Laboratory
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A

Course Content	The course is structured as follows: • In-depth study of CAD programs and the application of PLM and PDM systems • In-depth study of three-dimensional part creation in a CAD program • In-depth study of assembly creation from components in a CAD program • Introduction to the Model-Based Definition (MBD) concept and the application of MBD in the areas of manufacturing processes, strength analysis, sustainability assessment, and measurement technology • Reinforcement of lecture content and CAD skills through exercises and assignments
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Jannik Ludewig, Creo Parametric 10.0 for Advanced Users • Willis, Dogra, Creo Parametric 12.0: A Power Guide for Beginners and Intermediate Users, CADArtifex • https://www.bundesumweltministerium.de/faq/was-ist-ein-digitaler-produktpass • https://green-forum.ec.europa.eu/implementing-ecodesign-sustainable-products-regulation_en Additional reading list will be announced during the course.

MSE-B 20: Language 4

Module Name	Language 4
Recommended Prerequisites	None
Teaching Format	Seminar

Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country [where German is the language of instruction and learning]), students must enroll in elective courses or additional language courses within the Language 1/2/3/4/5 modules. Students learn and deepen their knowledge of the German language in a language course offered by the Language Center. The language level of the course is determined individually based on the students' existing German language proficiency. Students without prior German language courses are placed at the A2.2 level. Students develop proficiency in using German technical and scientific terminology through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Language Center Course: K60+M (Module Exam) (Module Grade) Applied Language 4: PA (ungraded)
Module Coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B4
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the Language Center

Name	as per the Language Center
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	According to the Language Center
(Course Objectives) (Skill acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading list	as per the Language Center

Course: Applied Language 4

Name	Applied Language 4
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions • Preparation for the internship semester
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 20: Electives 4

Module Name	Electives 4
Recommended Prerequisites	None
Course Format	Seminar

Learning Objectives	When submitting the declaration for the degree certificate, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), students must take courses from the elective area or additional language courses within the Language 1/2/3/4/5 modules. Students explore topics of their own choosing from the elective area or from the Language Center. Upon consultation with the Dean of Studies, courses from ZEF21, Challenge.EU, or other qualified courses (online) may also be taken. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	2 semesters
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	As determined by the instructor Elective Applied Language 4: PA (ungraded)
Module coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B4
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the elective course list

Name	as per the elective course list
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	as specified by the instructor Elective
(Course objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	German, English, or any other language
(Instructor)	N/A
Reading list	As specified by the instructor in the elective course

Course: Applied Language 4

Name	Applied Language 4
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions • Preparation for the internship semester
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective fundamental engineering disciplines.

MSE-B 21: Internship Semester

Module Name	Internship Semester
Recommended Prerequisites	N/A
Teaching Format	Practical and Academic Work

Learning Objectives	The goal of the practical study semester is to familiarize students with their chosen professional field through practical activities in the natural sciences or engineering at relevant companies or institutes, to the extent that students can meaningfully define their areas of focus and select courses according to their own interests. International students consolidate their German language skills through daily use, ideally achieving a B2 level.
Duration	1 semester
SWS	-
Workload	Course: - Self-study/group work: 900 h Workload: 900 hours
(Credits and Grades)	N/A
ECTS credits	30 (24+6)
Requirements for awarding credits	Internship Report: Report (ungraded) Scientific Report: Term paper (module grade) and presentation (coursework as part of the M+V Faculty's specialized colloquium)
Module Coordinator	Dean of Studies
(Max. participants)	N/A
Recommended Semester	MSE-B5
Frequency	Every semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Internship

Name	Internship
Type	Practical
No.	Course number according to StuPO
SWS	-
(Exam format)	N/A
Course Content	Students work in a company for 95 days of in-person instruction.
(Course Objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	German, possibly English depending on the internship site; German preferred
(Instructor)	N/A
Literature	Not applicable

Course: Scientific Report

Name	Scientific Report
Type	Scientific paper
No.	Course number according to StuPO
SWS	-
(Exam format)	N/A
Course Content	In conjunction with the internship semester, students write a term paper that summarizes the scientific background of their work and/or scientifically documents a project being carried out at the company. Consolidation and practice of the German language in the preparation of technical documentation.
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German preferred, English if necessary
(Instructor)	N/A
Reading list	Not applicable

MSE-B 22: Measurement and Control Engineering

Module Name	Measurement and Control Engineering
Recommended Prerequisites	Mathematics 1/2, Mechanics 1/2/3, Mechatronics, Thermodynamics, Fluid Engineering and Heat Transfer, Design 1/2
Teaching Format	Lecture and Lab
Learning Objectives	Upon completion of the module, students will be able to: • explain metrological principles and express them mathematically, • assess the information loss associated with digitization and avoid digitization errors • identify common sensor systems and their properties and applications, • set up a measurement chain, and • collect, evaluate, and present measurement data • You understand a signal as a physical quantity that carries information and are able to mathematically describe simple linear systems and analytically calculate simple overall systems.

	- You have sufficient abstract thinking skills to be able to estimate the behavior of nonlinear systems. - You are familiar with simple controllers and can parameterize them. Furthermore, you can identify systems that are unstable and demonstrate which measures can improve stability.
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Measurement and Control Engineering: K90 (Module Grade) Measurement Lab: Lab work (ungraded) (LA) Control Lab: Lab work (ungraded) (LA)
Module Coordinator	Prof. Marco Schneider
(Max. participants)	N/A
Recommended Semester	MSE-B6
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Measurement Engineering

Name	Measurement Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Fundamentals of Measurement Technology • Sensor systems for temperature, displacement, acoustic quantities, vibrations, force, and strain • Measurement systems for non-destructive testing • Measurement methods in manufacturing metrology
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Measurement Engineering Lab

Name	Measurement Engineering Lab
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The lab is structured as follows: • Introduction to LabView • Digital measurement data acquisition • Evaluation of measurement results from mechanical engineering and mechatronics perspectives
(Course objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

Course: Control Engineering in Mechanical Engineering

Name	Control Engineering in Mechanical Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	Basics - Introduction: System/Signal/Transfer Function - Definition and tasks of measurement and control technology - Representation of measurement and control tasks: notation, standards, symbols, block diagrams Review of complex numbers and functions - Standard form and the Gaussian plane, trigonometric form, exponential form - Calculations with complex numbers and functions: locus and Bode plot Fundamentals of systems theory - Physical process, technical process, technical/dynamic system - Input and output variables, system variables, system parameters, system analysis - Transfer behavior (in the time domain), transfer function, in particular impulse response, step response, and response to periodic excitation Linear, continuous-time systems in the time and frequency domains - Modeling of a transfer system (formulation of the differential equation), test and response functions - Linearization, transfer function, frequency response, elementary transfer elements, frequency representation of composite systems - Rewriting block diagrams - Application of the rules to various problems The control loop - Time response of typical controllers, standard control loop, control loop equation, tracking and disturbance response, static and dynamic behavior - Synthesis of control loops Stability and controller design in the time domain - Control loop parameters and stability criteria - Determination of controller parameters/tuning rules
(Course objectives) (Competency acquisition)	N/A

(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Literature	• Feedback Systems: An Introduction for Scientists and Engineers, Astrom, Murray, Princeton University Press, 2021 • Modern Control Systems, Richard C. Dorf, Robert H. Bishop, Pearson, 2017

Course: Control Engineering Lab

Name	Control Engineering Lab
Type	Lab
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The lab is structured as follows: • Introduction to practical controller design using a model • Digital measurement data acquisition • Control of various mechanical and mechatronic systems • Evaluation of results from mechanical engineering and mechatronic perspectives
(Course objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 23: Product Life Cycle Management

Module Name	Product Life Cycle Management
Recommended Prerequisites	All courses from Semesters 1 through 4
Course Format	Seminar
Learning Objectives	Upon completion of the module, students will be able to: • Manage and monitor technical projects with methodological confidence • Master and assess the uncertainties and problems of a development project • Apply the engineering fundamentals learned in semesters 1 through 4 and during the practical semester in a methodologically sound and integrated manner to technical product and process development
Duration	1 semester
SWS	4
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	<i>May be omitted</i>
ECTS credits	6
Requirements for awarding credits	PA (Module Grade)
Module coordinator	Prof. Günther Waibel
(Max. participants)	N/A
Recommended semester	MSE-B6
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Product Life Cycle Management

Name	Product Life Cycle Management
Type	Seminar
No.	Course number according to StuPO
SWS	4
(Exam format)	N/A
Course Content	The course is structured as follows: • Fundamentals of Product Development • Conceptualization and Methodical Design • Manufacturing and Work Planning • Time and Cost Accounting • Practical Application ○ Project Planning and Execution Using a Selection of the Following Tools: ○ Project management tools ○ Methodological problem-solving tools and software ○ Product and process development ○ CAD/CAE applications ○ Simulation ○ Manufacturing processes ○ Material and component testing • Documentation
(Course Objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	As posted
Literature	• Pahl/Beitz: Design Engineering. 9th edition, Springer Verlag, Berlin, 2021 (ISBN: 978-3-662-57302-0) • Koller, R.: Design Theory for Mechanical Engineering, 3rd edition, Springer Verlag, Berlin, Heidelberg, 1994 (ISBN: 978-3-540-57928-1) • Bansal, Project Management: Planning and Scheduling Techniques, E-resource: O'Reilly Online Learning • Olson, Project Management Tools, Springer An updated reading list will be announced during the course

MSE-B 24: Numerical Methods in Engineering

Module Name	Numerical Methods in Engineering
Recommended Prerequisites	Mathematics 1 and 2, Mechanics 1 through 4, Fluid Engineering, Thermodynamics, and Modeling and Simulation (CAE)
Teaching Format	Lecture and Lab
Learning Objectives	Students acquire in-depth knowledge in the field of computer-aided development and analysis of systems primarily in mechanical engineering, mechatronics, and biomechanics. Building on their acquired knowledge, they learn advanced methods of computer-aided product development. Students will be able to contribute to the analysis of problems in fluid mechanics, solid mechanics, electrical engineering, and related engineering disciplines using computer-aided methods. They will understand the capabilities and limitations of simulation methods. Using example applications from the fields of fluid mechanics, solid mechanics, or electrical engineering, students learn how to work with and apply 1D, 2D, and 3D simulation methods. They gain insight into the fundamental principles of operation, the implementation of their own simple numerical methods, and the use of commercial simulation applications. In addition, students master the typical application fundamentals of commercially available CAE systems. This enables future engineers to make technically sound decisions in their professional lives, independent of specific CAE applications, based on a solid knowledge of the fundamental techniques in the field of computer-aided development methods. Furthermore, this significantly facilitates their transition to company-specific software applications.
Duration	1 semester
SWS	4
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Numerical Methods in Engineering: K60 (module grade) Numerical Methods in Engineering - Lab: PA (ungraded)
Module Coordinator	Prof. Jörg Ettrich
(Max. participants)	N/A
Recommended Semester	MSE-B6

Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Numerical Methods in Engineering

Name	Numerical Methods in Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	2 hours per week
(Exam format)	N/A
Course Content	The course covers selected topics from • Classification of the terms CAD, CAE, CAM, FEM, MKS, CFD, and PDM within the development process. • Selection of fundamental cross-application possibilities of advanced computer-aided development techniques • Fundamental information technology and, in particular, the mathematical foundations of computer-aided development tools. • The basic approach to the modeling process, from physical models to mathematical models of mechanical engineering and mechatronics systems, with a focus on issues in fluid mechanics, solid mechanics, and related engineering disciplines • To be able to evaluate and apply the fundamental possibilities of computer-aided analysis across various applications. • In computer exercises, the methods are explored in depth using commercially available CAE software. • Various application examples
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A

Reading	The current reading list will be announced during the course.
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Course: Numerical Methods in Engineering Lab

Name	Numerical Methods in Engineering Lab
Type	Lab
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Computer exercises in fluid mechanics, solid mechanics, and advanced engineering sciences • Application of standard commercial and open-source CAE software • Various application examples in the individual engineering disciplines
(Course Objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading	The current reading list will be announced during the course.

MSE-B 25: Applied Fluid Engineering

Module Name	Applied Fluid Engineering
Recommended Prerequisites	Mathematics 1 and 2, Fluid Engineering, Thermodynamics
Teaching Format	Lecture and lab
Learning Objectives	Upon completion of the module, students will be able to: • Classify, evaluate, and calculate fluid power machines • Select the appropriate machine specifically for each application, taking into account the best efficiency

	- Assess and evaluate the advantages, disadvantages, and challenges of various fluid power machines and systems - Assess digital twins of machines and systems and evaluate them in terms of their application and benefits - Create, select, and deploy simple digital twins of machines and systems - Independently perform, evaluate, and interpret basic measurements on fluid power machines using exemplary laboratory test benches
Duration	1 semester
SWS	6
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Applied Fluid Engineering: K90 (module grade) Applied Fluid Engineering – Laboratory: PA (ungraded)
Module Coordinator	Prof. Jörg Ettrich
(Max. participants)	N/A
Recommended Semester	MSE-B6
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	Not applicable

Course: Applied Fluid Engineering

Name	Applied Fluid Engineering
Type	Lecture
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Classification of engines and machines • Energy balances • Fundamentals of fluid machinery • Classification and design, Euler's hydrostatic law, scaling of fluid machinery • Hydraulic flow machines • System/plant integration, impeller types (e.g., of a water turbine), design and control of Kaplan, Francis, and • Pelton turbines, dimensionless parameters and Cordier diagram, centrifugal pumps • Thermal Turbomachinery • Classification, steam turbine as an example of a multistage turbine, gas turbine • Positive-displacement machines • Fundamentals, example of a reciprocating compressor • Internal combustion engines • Thermodynamics of internal combustion engines, selected aspects
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	Prof. Jörg Ettrich
Literature	• Cornetti, Hydraulic Machines and Energy, Springer • Cornetti, Thermal Sciences for Machines, Springer An updated reading list will be provided during the course.

Course: Applied Fluid Engineering - Lab

Name	Applied Fluid Engineering - Lab
Type	Lab
No.	Course number according to StuPO
SWS	2 hours per week
(Exam format)	N/A
Course Content	The course is structured as follows: • Conducting various experiments on real fluid power machines, e.g., Kaplan turbine, Pelton turbine, reciprocating compressor, centrifugal fan, wind tunnel • Application of digital twins using various machines and systems as examples • Analysis and evaluation of the measurements and results obtained
(Course objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	Prof. Jörg Ettrich
Literature	• Cornetti, Hydraulic Machines and Energy, Springer • Cornetti, Thermal Sciences for Machines, Springer An updated reading list will be provided during the course.

MSE-B 26: Language 5

Module Name	Language 5
Recommended Prerequisites	None
Teaching Format	Seminar
Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If German language proficiency at the B2 level is already present (evidenced by German as a native language or a high school diploma from a German-speaking country [where German is the language of instruction and learning]), students must take elective courses or additional language courses within the Language 1/2/3/4/5 modules. Students learn and deepen their knowledge of the German language in a language course offered by the Language Center. The language level of the course is determined individually based on the students' existing German language proficiency. Students without prior German language courses must be at least at the B1 level. After the internship semester, students should ideally be able to achieve the B2 level. Students develop proficiency in using German technical and scientific terminology through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to address the potential variation in learning levels among the international students.
Duration	1 semester
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	Language Center course: K60+M (module exam) (module grade) Applied Language 5: PA (ungraded)
Module Coordinator	Prof. Christian Wetzol

(Max. participants)	N/A
Recommended Semester	MSE-B5
Frequency	Every summer semester
Applicability	Bachelor MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the Language Center

Name	According to the Language Center
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	According to the Language Center
(Course Objectives) (Skill acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	English
(Instructor)	N/A
Reading list	as per the Language Center

Course: Applied Language 5

Name	Applied Language 5
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	N/A
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions • Preparation for the bachelor's thesis
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 26: Electives 5

Module Name	Electives 5
Recommended Prerequisites	None
Teaching Format	Seminar

Learning Objectives	When submitting the declaration for the final transcript, proof of German language proficiency at least at level B1 according to the Common European Framework of Reference for Languages (CEFR) must be provided. The Language 1/2/3/4/5 modules, the practical study semester, and the bachelor's thesis are designed to help students achieve German language proficiency (Level B1). The language courses in the Language Modules 1/2/3/4/5 must be selected in such a way that an improvement from the respective starting level is achieved in every case. If If you have German language proficiency at the B2 level (as evidenced by German being your native language or a high school diploma from a German-speaking country where German is the language of instruction and learning), you must take courses from the elective area or additional language courses in the Language 1/2/3/4/5 modules. Students explore topics of their own choosing from the elective area or the Language Center. Upon consultation with the Dean of Studies, courses from ZEF21, Challenge.EU, or other qualified courses (online) may also be taken. Students develop proficiency in handling German-language technical and scientific terms through simple bilingual (English/German) subject-specific tasks and exercises. The exercises are individually tailored to account for the potential variation in learning levels among international students.
Duration	2 semesters
SWS	5
Workload	Course: 67.5 h Self-study/group work: 112.5 hours Workload: 180 hours
(Credits and Grades)	N/A
ECTS credits	6
Requirements for awarding credits	As determined by the instructor Elective Applied Language 5: PA (ungraded)
Module coordinator	Prof. Christian Wetzel
(Max. participants)	N/A
Recommended Semester	MSE-B6
Frequency	Every summer semester
Applicability	Bachelor's in MSE - Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course according to the elective course list

Name	as per the elective course list
Type	Seminar
No.	Course number according to StuPO
SWS	4 SWS
(Exam format)	N/A
Course Content	as specified by the instructor Elective
(Course objectives) (Skills acquired)	N/A
(Teaching and learning methods)	N/A
Course language	German, English, or any other language
(Instructor)	N/A
Reading list	As specified by the instructor Elective area

Course: Applied Language 5

Name	Applied Language 5
Type	Seminar
No.	Course number according to StuPO
SWS	1 SWS
(Exam format)	<i>Not applicable</i>
Course Content	The seminar is structured as follows: • Analysis of German/English texts to foster a better understanding of German texts, assignments, and exercises • Individual assignment of German/English practice exercises to continue to effectively balance the heterogeneity of students' learning levels. • Analysis and comprehension of German texts, assignments, and exercises with the help of translation programs and AI applications • Exercises and assignments on academic work and the writing of technical reports and documentation • Presentations by and field trips to regional companies and institutions • Preparation for the bachelor's thesis
(Course learning objectives) (Competency acquisition)	N/A
(Teaching and learning methods)	N/A
Course language	German and English
(Instructor)	Christian Wetzel
Reading list	A reading list will be announced individually during the seminar and is based on the technical literature of the respective engineering fundamentals.

MSE-B 27: Electives

Module Name	Elective Area
Recommended Prerequisites	as posted

Teaching Format	as posted
Learning objectives	as posted
Duration	as posted
SWS	as posted
Workload	Course: as posted Self-study/group work: as posted Workload: 360 hours
(Credits and Grades)	<i>Not applicable</i>
ECTS credits	12
Requirements for awarding credits	as posted
Module coordinator	Dean of Studies
(Max. participants)	N/A
Recommended semester	Starting in MSE-B3
Frequency	Every semester
Applicability	MSE-B (Advanced Studies)
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

MSE-B 28: Scientific Writing and Bachelor's Thesis

Module Name	Scientific Writing and Bachelor Thesis
Recommended Prerequisites	N/A
Teaching Format	Seminar and Academic Writing
Learning Objectives	The “Bachelor’s Thesis” module is designed to enable students to independently conduct academic research on a research or development question within the field of study. The Bachelor’s Thesis serves as academic proof that students are capable of independently addressing a problem within their field of study using academic methods within a specified timeframe.
Duration	1 semester. The course “Scientific Work” must be taken in a different semester than the courses “Final Colloquium” and “Bachelor’s Thesis.”
SWS	3
Workload	Course: 33.75 h Self-study/group work: 506.25 hours

	Workload: 540 hours
(Credits and Grades)	N/A
ECTS credits	18
Requirements for awarding credits	Scientific Research and Writing: Presentation (ungraded) Final Presentation: Colloquium Weighting of module grade: 1/5 Bachelor's Thesis: Final Thesis Weighting of module grade: 4/5
Module Coordinator	Dean of Studies
(Max. participants)	N/A
Recommended Semester	MSE-B7, course "Scientific Research and Writing" in MSE-B3 or MSE-B4
Frequency	Every semester
Applicability	Bachelor's in MSE – Advanced Studies
(Methodology)	<i>Not applicable</i>
(Other notes, information)	<i>Not applicable</i>

Course: Scientific Research and Writing

Name	Scientific Research and Writing
Type	Seminar
No.	Course number according to StuPO
SWS	2 SWS
(Exam format)	N/A
Course Content	The course is structured as follows: • Introduction to scientific methods • Literature research and evaluation • Citation rules and plagiarism prevention • Structure of academic texts • Presentation techniques The schedule is as follows: Input phase • Academic Writing (2 lecture hours) • Scientific theory “What is knowledge” + scientific ethics, fundamentals of scientific work (DFG) (1 lecture) • Literature, Sources, Plagiarism, AI (if applicable, from/with the library) (1 lecture hour) • Academic presentations (1 lecture hour) • DoE (1 lecture hour) • Special formats, peer review process, feedback guidelines (1 lecture) Work phases during the semester • Revision of own previous texts (1 DS) • Peer review of the abstract (1 lecture hour) (see below) • Peer review of presentations (2–3 class sessions) (see below) Work phases at home • Prepare an abstract or similar (3–5 pages) • Preparing and delivering a scientific presentation This course should be taken in the 3rd or 4th semester. Due to the departmental colloquium of the M+V Faculty, the entire module is not completed until the 7th semester.
(Course learning objectives) (Competency acquisition ²)	N/A
(Teaching and learning methods)	N/A
Course language	English and, if applicable, German, provided students have B2-level proficiency in German
(Instructor)	N/A

References	• Thomas Plümper, Efficient Writing: A Guide to Writing Theses and Academic Texts (3rd ed.), Oldenbourg Verlag, Munich, 2013 • Day, R. A. & Gaster, B.: How to Write and Publish a Scientific Paper; Cambridge University Press; 2018
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Course: Final Presentation

Name	Final Presentation
Type	Seminar
No.	Course number according to StuPO
SWS	1
(Exam format)	N/A
Course Content	• Presentation of work results • Discussion with examiners and fellow students • Placement of the work within the research context The prerequisite for admission is proof of attendance at a minimum of 20 lectures as part of the M+V seminar series.
(Course Objectives) (Competency acquisition ³)	N/A
(Teaching and learning methods)	N/A
Course language	English or German (preferably German)
(Instructor)	N/A
Reading list	N/A

Course: Bachelor's Thesis

Name	Bachelor's Thesis
Type	Academic Thesis
No.	Course number according to StuPO
SWS	N/A
(Exam format)	N/A
Course Content	• Analysis of a self-selected or assigned research question • Application of scientific methods and techniques • Preparation of a written research paper in accordance with formal requirements
(Course learning objectives) (Acquisition of competencies ⁴)	N/A
(Teaching and learning methods)	N/A
Course language	N/A
(Instructor)	N/A
Reading list	N/A