Technische Hochschule
Brandenburg
University of
Applied Sciences

Unofficial Translation of

Study and Examination Regulations for the Master's Degree Programme in Mechanical Engineering (SPO-MEng-ME-2025) dated 18 June 2025

Disclaimer:
This is an unofficial translation of the original German version of the "Studien- und Prüfungsordnung für den Masterstudiengang Mechanical Engineering (SPOMEng-ME-2025) vom 18.06.2025". Only the German version is legally binding.

Faculty of Engineering, Dean
Brandenburg University of Applied Sciences
Magdeburger Str. 50
14770 Brandenburg an der Havel
T +49 3381 355 – 0, F +49 3381 355 - 199

Study and Examination Regulations for the Master's Degree Programme in Mechanical Engineering (SPO-MEng-ME-2025) dated 18 June 2025

Based on:

- §§ 5 (1) sentence 2, 20 (2), 23 (2), and 81 (2) No. 1 of the Brandenburg Higher Education Act (BbgHG) of 9 April 2024 (GVBl. I/24 [No. 12]), as last amended by Article 2 of the Act of 21 June 2024 (GVBl. I/24 [No. 30], p. 32), in conjunction with § 11 (1) No. 1 of the Basic Regulations of the Brandenburg University of Applied Sciences (GrO) as amended by the announcement of 18 November 2021 (Official Announcements of Brandenburg University of Applied Sciences, p. 4659), and the regulations in the Framework Regulations for Study and Examination Regulations of Brandenburg University of Applied Sciences (RO-THB) as amended by the announcement of 12 January 2023 (Official Announcements of Brandenburg University of Applied Sciences, p. 4880),
- the Ordinance on the Design of Examination Regulations to Ensure the Equivalence of Studies, Examinations, and Degrees (University Examination Ordinance - HSPV) of 4 March 2015 (GVBl. II/15 [No. 12]), as last amended by the Act of 9 April 2024 (GVBl. I/24 [No. 12]), and
- the Ordinance on the Regulation of Programme Accreditation (Study Accreditation Ordinance - StudAkkV) of 28 October 2019 (GVBl. II/19 [No. 90])

the Faculty Council of the Department of Engineering, by resolution dated 18 June 2025, enacts the following Study and Examination Regulations for the Master's Degree Programme in Mechanical Engineering (SPO-MEng-ME-2025):[1]

Table of Contents

[1] Approved by letter of the President dated 26 June 2025.

§ 1 Scope

(1) These regulations govern the objectives, content, structure, admission requirements, and timeline of the Master's degree programme in Mechanical Engineering at the Department of Engineering of Brandenburg University of Applied Sciences. They supplement the general framework for study and examination regulations of Brandenburg University of Applied Sciences (RO-THB) in its current version.

(2) These regulations apply to students who enroll starting in the winter semester 2025/26.

§ 2 Objectives of the Study Programme

(1) The Master's degree programme in Mechanical Engineering (M.Eng.) is an application-oriented, consecutive, English-language programme designed to broaden subject-specific knowledge.

(2) The aim of the programme is to provide a holistic view of modern machines in which systems or components from various engineering disciplines are integrated and interact. It examines both the mechanical and electronic interaction of specific assemblies as well as the exchange of energy, materials, and information with the environment. Systemic interactions in mechanical engineering include power flows, energy conversions, optimization of overall efficiency, and machine dynamic responses. Special emphasis is placed on sustainable resource use and comprehensive life cycle assessments, including environmental impact. The programme imparts advanced knowledge in the design of control loops, the programming of fault-tolerant software, and creative-constructive approaches to component design and material selection. Students learn to independently or collaboratively solve tasks involving calculations or simulations. Project experience can be gained through a collaboratively developed interdisciplinary project, which is thematically linked to the master's thesis. The development of integrated systems also takes into account unavoidable disturbances and tolerances to ensure the overall system is designed to be stable, safe, and reliable. The degree programme equips students to conduct independent scientific work in application-oriented research and development.

(3) The dual study format pursuant to § 7 combines the university as a place of learning with practical training in a company setting. It is characterized by a particularly strong practical orientation.

§ 3 Academic Degree

(1) Upon successful completion of the program, the university awards the academic degree "Master of Engineering" (abbreviated M.Eng.).

(2) The dual study format pursuant to § 7 is indicated on the certificate and in the Diploma Supplement. Successfully completed transfer modules are recorded on the certificate.

§ 4 Specific Admission Requirements

(1) Admission requires a first professionally qualifying university degree in mechanical engineering or a comparable field, with at least 210 earned credit points. Degree programs are considered comparable if they include mechanical engineering modules totaling at least 60 credit points. The thesis and the colloquium for the thesis are not included in the calculation of these 60 credit points.

(2) If the 210 credit points specified in paragraph 1 are not achieved, admission is possible with a minimum of 180 earned credit points. In this case, admission is subject to conditions. These conditions are determined by the examination board and may comprise up to 30 additional credit points. These credit points are not counted toward the Master's program. Fulfillment of all conditions is a prerequisite for the assignment of the Master's thesis topic in accordance with § 8 paragraph 2.

(3) Proof of English language proficiency at a minimum level of B2 of the Common European Framework of Reference for Languages (CEFR) must be provided.

(4) Contracts as set out in § 7 paragraph 2 are required for participation in the dual study format.

§ 5 Scope of Study, Standard Period of Study, and Commencement

(1) The programme comprises 90 credit points in accordance with the European Credit Transfer and Accumulation System (ECTS). One credit point corresponds to a workload of 30 hours.

(2) The standard period of study is three semesters for full-time study. For part-time study, the standard period of study is five semesters.

(3) Enrolment in the first semester takes place semiannually, in both the summer and winter semesters.

§ 6 Structure and Organization of the Study Programme

(1) The programme is conducted as an on-campus course.

(2) The programme includes:

1. six compulsory modules totaling 36 credit points,
2. three elective modules from elective catalogue ME-A (Appendix 3) totaling 18 credit points,
3. one elective module from elective catalogue ME-B (Appendix 3) totaling 6 credit points,
4. the master’s thesis with colloquium totaling 30 credit points.

(3) The standard study plan is provided in Appendix 1 for full-time study and in Appendix 2 for part-time study. These plans allocate modules by semester for enrolment in the summer semester. For enrolment in the winter semester, modules assigned to semester 2 apply to the first semester, and those assigned to semester 1 apply to the second semester, and so on. Module descriptions, including content, teaching and learning methods, prerequisites, assessment methods, workload, and qualification objectives, are included in Appendix 4.

(4) Students must register their choice of elective modules by the end of the tenth week of the semester using the provided registration list submitted to the examination office. Once registered, elective modules are considered mandatory and automatically included in examination registration as per § 12 paragraph 2 of the RO-THB.

(5) The second semester of the full-time programme and the third and fourth semesters of the part-time programme serve as mobility windows for study at other national or international universities.

(6) The language of instruction and examination is English.

§ 7 Dual Study Format

(1) The programme can be completed in a practice-integrated dual format. In this case, the academic part is conducted as full-time or part-time study at the university, and the practical part takes place in a company or institution. The integration of both parts is achieved through transfer modules and the master's thesis.

(2) Requirements for the dual study format include:

1. an education contract for the dual study programme between the student and a company or institution, and
2. a cooperation agreement for the dual study programme between the university and the company or institution.

(3) A transfer module includes courses at the university and a practical part in the company or institution. The assessment is based on a graded transfer report.

(4) Three modules in the curriculum are to be completed as transfer modules. These modules are indicated in the study plans and elective catalogues.

(5) Participation in the dual study format must be declared upon enrolment. The required contracts according to paragraph 2 must be provided.

(6) If the education contract is terminated prematurely, the programme can be continued in the non-dual study format.

§ 8 Master's Thesis with Colloquium

(1) The master's thesis with colloquium is intended to address a comprehensive topic and develop a practical or theoretical solution. It demonstrates that students can independently work on a task typical of professional practice using scientific and engineering methods within a set timeframe.

(2) The topic of the master's thesis will be assigned only after all other study and examination requirements for graduation have been successfully completed.

(3) The thesis period is five months.

(4) The master's thesis with colloquium must be conducted in English.

(5) The overall grade for the master's thesis and colloquium is composed of 75% from the thesis grade and 25% from the colloquium grade.

§ 9 Final Grade Calculation

The final grade is calculated as follows: 30% from the master's thesis with colloquium, and 70% from the weighted average of all other module grades based on credit points.

§ 10 Entry into Force, Expiry, and Transitional Provisions

(1) These regulations come into effect the day after publication in the Official Announcements.

(2) The Study and Examination Regulations for the Master's degree programme in Maschinenbau dated 26 June 2024 (Official Announcements No. 12, 32nd Year 2024) will cease to be in force on 31 August 2028.

(3) Students enrolled under the previous regulations may apply to be transferred to these new regulations.

Brandenburg an der Havel, 26.06.2025

Signed:
Prof. Dr. Andreas Wilms
President

Appendices

Appendix 1 Curriculum and Examination Plan for Full-Time Study
Appendix 2 Curriculum and Examination Plan for Part-Time Study
Appendix 3 Elective Catalogues
Appendix 4 Module Descriptions

Appendix 1 Curriculum and Examination Plan for Full-Time Study

Semester	Module (German title in italics)	CP	Teaching and Learning Formats in CHW						Assessment type	T	Grade Weighting
			V	Ü	L	S	P	Σ			
1	Drive Dynamics and Simulation of Kinematic Systems *Antriebsdynamik und Simulation kinematischer Systeme*	6	3	1				4	K		6/60
	Mathematical Optimization *Mathematische Optimierung*	6	3	1				4	K, M		6/60
	Energy and Resource Management *Energie- und Ressourcenmanagement*	6	3	1				4	K, SPA	T	6/60
	Elective Module 1 (Elective Catalogue ME-A) *Wahlpflichtmodul 1 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
	Elective Module 2 (Elective Catalogue ME-A) *Wahlpflichtmodul 2 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
	1. Semester ∑	30	15	5	0	0	0	20			
2	Material Selection and Design Optimization *Werkstoffauswahl und Bauteiloptimierung*	6	3	1				4	K, SPA	T	6/60
	Development of Fault Tolerant Software for Embedded Realtime Systems *Entwicklung fehlertoleranter Software für eingebettete Echtzeitsysteme*	6	3	1				4	K, SPA		6/60
	Scientific Project *Wissenschaftliche Projektarbeit (WPA)*	6	2				2	4	PE, SPA		6/60
	Elective Module 3 (Elective Catalogue ME-A) *Wahlpflichtmodul 3 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
	Elective Module 4 (Elective Catalogue ME-B) *Wahlpflichtmodul 4 (Wahlpflichtkatalog ME-B)*	6	3*	1*				4			6/60
	2. Semester ∑	30	14	4	0	0	2	20			
	Modules ∑	60	29	9	0	0	2	40			60/60

* The specifications are provided in the elective module catalogs.

Semester	Master's Thesis and Colloquium (German title in italics)	CP	Teaching and Learning Formats in CHW							Grade Weighting
			V	Ü	L	S	P	Σ		
3	Master Thesis *Masterarbeit*	27					5	5		3/4
	Master Colloquium *Kolloquium zur Masterarbeit*	3					1	1		1/4
	3. Semester ∑	30	0	0	0	0	6	6		
	Master's Thesis and Colloquium ∑	30	0	0	0	0	6	6		4/4

	CP	Teaching and Learning Formats in CHW							Final Grade Weighting
		V	Ü	L	S	P	Σ		
Modules ∑	60	29	9	0	0	2	40		70/100
Master's Thesis and Colloquium ∑	30	0	0	0	0	6	6		30/100
Master's Degree Programme ∑	90	29	9	0	0	8	46	Final Grade	100/100

Abbreviations:

CP	Credit points
CHW	Contact Hours per Week
∑	Sum
T	Transfer module

Teaching and Learning Formats	
L	Laboratory Practicum
P	Project
S	Seminar
Ü	Exercise
V	Lecture

Assessment type	
E	Electronic Examination
K	Written Examination
M	Oral Examination
oB	without grade
PE	Project Result
SPA	Other Written and Practical Work

Appendix 2 Curriculum and Examination Plan for Part-Time Study

Semester	Module (German title in italics)	CP	Teaching and Learning Formats in CHW V	Ü	L	S	P	Σ	Assessment type	T	Grade Weighting
1	Drive Dynamics and Simulation of Kinematic Systems *Antriebsdynamik und Simulation kinematischer Systeme*	6	3	1				4	K		6/60
1	Energy and Resource Management *Energie- und Ressourcenmanagement*	6	3	1				4	K, SPA	T	6/60
1	Elective Module 1 (Elective Catalogue ME-A) *Wahlpflichtmodul 1 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
	1. Semester ∑	18	9	3	0	0	0	12			
2	Material Selection and Design Optimization *Werkstoffauswahl und Bauteiloptimierung*	6	3	1				4	K, SPA	T	6/60
2	Elective Module 3 (Elective Catalogue ME-A) *Wahlpflichtmodul 3 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
2	Elective Module 4 (Elective Catalogue ME-B) *Wahlpflichtmodul 4 (Wahlpflichtkatalog ME-B)*	6	3*	1*				4			6/60
	2. Semester ∑	18	9	3	0	0	0	12			
3	Mathematical Optimization *Mathematische Optimierung*	6	3	1				4	K, M		6/60
3	Elective Module 2 (Elective Catalogue ME-A) *Wahlpflichtmodul 2 (Wahlpflichtkatalog ME-A)*	6	3*	1*				4			6/60
	3. Semester ∑	12	6	2	0	0	0	8			
4	Development of Fault Tolerant Software for Embedded Realtime Systems *Entwicklung fehlertoleranter Software für eingebettete Echtzeitsysteme*	6	3	1				4	K, SPA		6/60
4	Scientific Project *Wissenschaftliche Projektarbeit (WPA)*	6	2				2	4	PE, SPA		6/60
	4. Semester ∑	12	5	1	0	0	2	8			
	Modules ∑	60	29	9	0	0	2	40			60/60

* The specifications are provided in the elective module catalogs.

Semester	Master's Thesis and Colloquium (German title in italics)	CP	Teaching and Learning Formats in CHW V	Ü	L	S	P	Σ		Grade Weighting
5	Master Thesis *Masterarbeit*	27					5	5		3/4
5	Master Colloquium *Kolloquium zur Masterarbeit*	3					1	1		1/4
	5. Semester ∑	30	0	0	0	0	6	6		
	Master's Thesis and Colloquium ∑	30	0	0	0	0	6	6		4/4

	CP	Teaching and Learning Formats in CHW V	Ü	L	S	P	Σ		Final Grade Weighting
Modules ∑	60	29	9	0	0	2	40		70/100
Master's Thesis and Colloquium ∑	30	0	0	0	0	6	6		30/100
Master's Degree Programme ∑	90	29	9	0	0	8	46	Final Grade	100/100

Abbreviations:

CP	Credit points
CHW	Contact Hours per Week
∑	Sum
T	Transfer module

Teaching and Learning Formats	
L	Laboratory Practicum
P	Project
S	Seminar
Ü	Exercise
V	Lecture

Assessment type	
E	Electronic Examination
K	Written Examination
M	Oral Examination
oB	without grade
PE	Project Result
SPA	Other Written and Practical Work

Appendix 3 Elective Catalogues

Elective Catalogue ME-A									
Module **(German title in italics)**	**Cycle**	**LP**	**Teaching and Learning Formats in CHW**					**Assessment type**	**T**
			V	**Ü**	**L**	**S**	**P**		
Innovative Joining Technologies Lab *Innovative Fügetechnik Lab*	S	6	2		2			K, M, SPA	
Lightweight Design *Leichtbau*	S	6	4					K, M, SPA	T
Modeling and Simulation of Dynamic Systems *Modellierung und Simulation dynamischer Systeme*	S	6	4					SPA	
Non-linear Finite Element Analysis *Nichtlineare Finite Elemente Methode*	S	6	3		1			K, M, SPA	
Product Cost Calculation and Optimization *Produktkostenkalkulation und Optimierung*	S	6	3	1				K, M, SPA	
Computational Fluid Dynamics *Computational Fluid Dynamics*	W	6	3	1				K, M, SPA	
Development of Autonomous Mobile Systems *Entwicklung autonomer mobiler Systeme*	W	6	2		2			SPA	
Energy and Resource Efficient Manufacturing Technology *Energie- und Ressourceneffiziente Fertigungstechnik*	W	6	2				2	PE	
Laser Material Manufacturing *Lasermaterialbearbeitung*	W	6	2	1	2			K, M, SPA	

Elective Catalogue ME-B									
Module **(German title in italics)**	**Cycle**	**LP**	**Teaching and Learning Formats in CHW**					**Assessment type**	**T**
			V	**Ü**	**L**	**S**	**P**		
Environmental Economics *Umweltökonomie*	W	6	4					K	
Economy for Engineers *Wirtschaft für Ingenieure*	W	6	2	2				K, M, SPA	
Laser technology *Lasertechnik*	S	6	2	1	1			K	

Abbreviations:

CP	Credit points
CHW	Contact Hours per Week
T	Transfer module

Cycle	
W	Winter semester
S	Summer semester

Teaching and Learning Formats	
L	Laboratory Practicum
P	Project
S	Seminar
Ü	Exercise
V	Lecture

Assessment type	
E	Electronic Examination
K	Written Examination
M	Oral Examination
oB	without grade
PE	Project Result
SPA	Other Written and Practical Work

Appendix 4 Module Descriptions

Drive Dynamics and Simulation of Kinematic Systems *Antriebsdynamik und Simulation kinematischer Systeme*				Module english *german*
Credit points 6	Teaching and Learning Formats in Contact Hours per Week 3 Lecture, 1 Exercise	Assessment type K	Participation Requirements None	Overall Qualification M.Eng.

Content

- Structure and functions of drive systems (DS)
- Force and motion transmission/power flow in DS
- Resistance characteristics of typical working machines/selected power demands
- Drive machines and mechanical characteristics
- Interaction of drive and working machines
- Static and dynamic stability of operating points
- Static and dynamic torque balance, dynamic fundamental equation of drive technology
- Calculation models for the "rigid" machine / model derivation
- Reduction of inertias, forces, and motion parameters in existing gear ratios
- Start-up, braking, and transitional processes; calculation using simplifications, linearisations, and graphical methods
- Simulation of DS with nonlinearities and branched structures (object-oriented simulation software SimulationX)
- Investigation of the dynamic behaviour of selected drivetrain configurations
- Influence of parameters and identification via simulation
- Vibrations in the drivetrain, clutch judder, drivetrain shudder

Learning Outcomes

Students are familiar with the basic structure of drive systems, particularly the requirements of vehicle drives, and are able to size the main components. They understand the holistic interactions of all assemblies during typical dynamic motion phases. They are proficient in approximate calculations as well as systematic analyses of specific drivetrain configurations, including with the aid of simulation methods.

Computational Fluid Dynamics *Computational Fluid Dynamics*				Module english *german*
Credit points 6	Teaching and Learning Formats in Contact Hours per Week 3 Lecture, 1 Exercise	Assessment type K, M, SPA	Participation Requirements None	Overall Qualification M.Eng.

Content

The lecture covers the following topics:
- Introduction to conservation equations
- Turbulence (energy cascade)
- Reynolds averaging of the Navier-Stokes equations
- Turbulence modelling, wall treatment
- Discretisation (finite volume method)
- Solution methods
- Unsteady flow, pressure correction
- Free surfaces

The exercise covers:
- Presentation of different meshing methods
- Introduction to CFX (Pre, Solve, Post)
- Calculation of an aerofoil, variation of angle of attack
- Testing of different turbulence models
- Grid study
- Calculation of a roll tank

Learning Outcomes

By the end of the module, students should have an overview of the theoretical fundamentals of numerical fluid dynamics (CFD – Computational Fluid Dynamics), enabling them to understand and appropriately apply the choice of methods in modern flow simulation programs. In the exercises, students work with the programs ANSYS Fluent or ANSYS CFX, which they are expected to learn to use confidently. By the end of the lectures, students should have the ability to independently tackle basic fluid dynamics problems.

Energy and Resource Efficient Manufacturing Technology

Energie- und Ressourceneffiziente Fertigungstechnik

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	2 Lecture, 2 Project	PE	None	M.Eng.

Content

- Introduction: energy, energy efficiency, resources, resource efficiency, necessity, strategies
- Need for energy- and resource-efficient manufacturing
- Product development: technical system, product life cycle, development process, types of development, development tools, technical documentation
- Manufacturing technology: classification, production organisation, manufacturing processes, production resources
- Energy- and resource-efficient manufacturing technology: systematisation, approaches, promotion
- Scientific work: literature, structuring, formatting, writing, figures, tables, posters, presentation

Learning Outcomes

Students can explain the fundamentals of product development, manufacturing technology, and energy and resource efficiency; name, explain, classify, and systematise approaches to energy and resource efficiency in manufacturing technology; describe the current state of energy and resource efficiency in manufacturing technology; analyse scientific papers and present their results; work on a specific area of specialisation within a project and team structure; and combine what they have learned into an overall understanding of the topic.

Energy and Resource Management

Energie- und Ressourcenmanagement

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Exercise	K, SPA	None	M.Eng.

Content

The course content covers fundamental technical and techno-economic principles of energy and resource provision and utilisation. The analysis considers both entire systems and subsystems along the market stages of important energetic and natural resources. These are examined from technical and economic perspectives, current and future problems are identified, and solution concepts are developed.
Focus areas: technical and economic principles of energy use, provision and utilisation of resources, regulatory frameworks in the energy and raw materials sector, systems and plants for resource use in the areas of conventional and renewable energies as well as natural raw materials, technical characteristics of energy and resource chains, fundamentals of energy management, environmental impacts as well as technical and economic methods and instruments for environmental and climate protection, price formation on markets for energy and natural resources, emissions trading – technical and economic consequences.

Learning Outcomes

Students understand that the supply of energy and raw materials forms the basis for life and economic activity, and that this is situated within the classical sustainability triangle of supply security, affordable prices, and environmental and nature protection.
Students can contextualise that this has been noticeable in Germany, Europe, and worldwide within the ongoing "energy transition" for decades and up to the present day.
Students recognise that energy and raw materials are the foundation of our prosperity. They also understand this as a source of global conflict, which, despite numerous international summits, climate conferences, and progressive activities, has still not been resolved.
Students have a fundamental understanding of systemic interrelationships in the field of energy and resources. They can describe the technical and economic connections along the value chain in the field of energy and resources, and analyse and work with the relevant technologies.
Through lectures (case studies, standards family around ISO 50001) and teamwork, students are qualified to solve complex tasks in the areas of energy and resource management.

Development of Autonomous Mobile Systems
Entwicklung autonomer mobiler Systeme

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	2 Lecture, 2 Laboratory	SPA	None	M.Eng.

Content

Modern evolutionary methods of artificial intelligence and optimisation, particularly swarm robotics and neuro-fuzzy. Methods of telemetry and trajectory planning; human and vehicle safety and interaction; hardware and software architecture for autonomous mobile systems, particularly bus systems, sensors and actuators, as well as power supply; investigations into availability and maintenance; treatment of suitable mechatronic base platforms; concrete exemplary implementation (possible examples: museum guide, security patrol, shopping trolley).

Learning Outcomes

Students have an in-depth understanding of the fundamental challenges in developing autonomous mobile systems. They independently develop functional prototypes in the field of autonomous mobile systems.

Development of Fault Tolerant Software for Embedded Realtime Systems
Entwicklung fehlertoleranter Software für eingebettete Echtzeitsysteme

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Exercise	K, SPA	None	M.Eng.

Content

Basic concepts of fault-tolerant software.
Design and programming of real-time systems.
Testing.
Optimisation of timing behaviour and platform transcription of libraries.
Petri nets and Java, particularly exception handling, concurrency, Java Native Interface, and interfaces.

Learning Outcomes

Students independently design and implement a real-time application with fault-tolerant properties.
Students are able to independently apply design patterns and patterns of fault-tolerant software to a specific application case and implement them.
Students have an in-depth understanding of the challenges in designing fault-tolerant software, particularly the specifics of fault-tolerant real-time systems.

Innovative Joining Technologies Lab
Innovative Fügetechnik Lab

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	2 Lecture, 2 Laboratory	K, M, SPA	None	M.Eng.

Content

Innovative joining processes and adaptive control with strong relevance to industrial practice, zero-defect production

Learning Outcomes

The student is enabled to select innovative joining processes, in addition to the basic scope from joining technology in the B.Eng., with regard to technological requirements and cost-effectiveness, and to apply them optimally under technological, economic, and ecological aspects, together with all components and as an overall system for a given manufacturing problem.
In laboratory exercises building on the lectures, the student learns the principles, selection, and specific application of innovative joining processes in industry-related examples through their independent application, and can select and handle suitable materials. Furthermore, they can apply these processes in robust automated use, including integrated process monitoring in a holistic approach, as well as their mechanisation or automation up to weld seam inspection. In addition, they acquire advanced theoretical knowledge to understand joining processes, e.g., depending on materials and process parameters, and in-depth skills to assess the suitability and practical application of testing methods used, as well as the integration of sensors.
The student thus acquires advanced expertise for the development, planning, execution, and control of joining production systems and their mechanised operation in modern industrial production.

Master Colloquium *Kolloquium zur Masterarbeit*			Module english *german*
Credit points 3	Teaching and Learning Formats in Contact Hours per Week 1 Project	Participation Requirements Admission: see examination regulations	Overall Qualification M.Eng.
Content After successfully completing the master's thesis, the candidate explains their work in a colloquium.			
Learning Outcomes Students learn and practise presenting and discussing their own results; they also acquire skills in scientific work.			

Laser Material Manufacturing *Lasermaterialbearbeitung*				Module english *german*
Credit points 6	Teaching and Learning Formats in Contact Hours per Week 2 Lecture, 1 Exercise, 2 Laboratory	Assessment type K, M, SPA	Participation Requirements None	Overall Qualification M.Eng.
Content - Introduction: definition, history, beam sources, classification, advantages, significance - Manufacturing technology: classification, production organisation, processes and resources - Laser systems: structure, beam guidance, beam shaping, handling, simulation - Laser-material interaction: phases, coupling, heating, transformation - Surface modifications: phenomena, thresholds, incubation, surfaces, LIPSS - Laser processes: laser welding, cutting, drilling, ablation, structuring - Laser safety: regulations, hazards, laser classes, protective measures				
Learning Outcomes Students can explain the fundamentals of manufacturing technology, the structure and function of laser systems, describe the basics of laser-material interaction, explain the fundamentals of laser-induced surface modifications, describe the key processes of laser material processing, describe and implement the fundamentals of laser safety, operate laser systems and characterise irradiation results, and consolidate what they have learned into an overall understanding of the topic.				

Laser technology
Lasertechnik

Module
english
german

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	2 Lecture, 1 Exercise, 1 Laboratory	K	None	M.Eng.

Content

Fundamental properties of light: light as particle, light as wave, polarisation, diffraction, interference, coherence;
Light-matter interaction: absorption and emission, optical amplification, line shape, linewidth, line broadening (homogeneous, inhomogeneous);
Basic structure of a laser: history, design, modes, Gaussian beam, properties, parameters;
Optical components in laser technology: mirrors, switches, modulators;
Pulsed operation: relaxation oscillations, gain-switching, Q-switching, cavity dumping, mode locking, pulse compression, chirped pulse amplification;
Frequency modification: selection, conversion, tuning;
Realisation of selected laser types: solid-state lasers, semiconductor lasers, gas lasers, dye lasers;
Characterisation of laser radiation: power, beam profile, pulse duration;
Applications of laser technology: measurement technology, manufacturing technology, medical technology, consumer goods;
Laser safety: hazards, standards, laser classes, protective measures.

Learning Outcomes

Students can list the main hazards, standards, and protective measures relating to laser safety. They can present the most significant applications of laser technology. Students can explain both the basic principle and the fundamental structure of a laser, as well as compare different laser systems in terms of their design and function. They can apply basic concepts and calculations in laser technology. Students can select laser systems for specific applications based on their properties and parameters. They can recognise and structure the relationships between the fields of optics, laser technology, and laser material processing. They can analyse and assess the characteristics of a laser device. Students can check and critically evaluate the safety of a laser device according to relevant criteria and standards. They are able to consolidate what they have learned into an overall understanding of laser technology. Students can plan and conduct development projects in laser laboratories. They are able to discuss and solve tasks in a team. Students can systematically obtain the information required for commissioning a laser system (internet, data sheets, technical literature, etc.). They are able to systematically analyse novel tasks and independently develop suitable solution approaches.

Lightweight Design
Leichtbau

Module
english
german

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	4 Lecture	K, M, SPA	None	M.Eng.

Content

Introduction: examples/applications; cost/benefit; designs/materials/performance indicators
Elasticity theory: plane stress state (PSS); plane strain state (PES); constitutive law
Isotropic panels and plates: differential equations and solutions; cut-outs; instabilities: buckling, pipe buckling
Thin-walled section beams: axial force and bending, neutral axis, principal axes of inertia; shear force and shear centre; torsion and warping torsion
Anisotropic panels and plates: strength theory; section loads, deformations; buckling
Sandwich panels: strength theory; section loads, deformations; buckling
Dynamics: rotating and oscillating components; first- and second-order theory

Learning Outcomes

Students
- know the load-bearing and deformation behaviour of typical lightweight structures (panels, shells, plates, thin-walled profiles, sandwich structures, etc.) and are able to make analytical estimates of their behaviour.
- are able to define idealisations for real structures, derive mechanical substitute models, and appropriately decompose structures into substructures.
- learn, through examples, how to use FEM and methods of virtual product development.
- know typical designs, strategies, principles, performance indicators, and materials of lightweight construction.
- understand the advantages of lightweight structures for dynamic processes and acquire the basics of elastodynamics of lightweight structures.
- gain insight into current developments in manufacturing technology and development methods.

Master Thesis
Masterarbeit

Module english / *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Participation Requirements	Overall Qualification
27	5 Project	Admission: see examination regulations	M.Eng.

Content

Independent scientific work to solve engineering problems.
Completion of the task in written and, if applicable, practical form.
Content depends on the specific task.

Learning Outcomes

Students can independently and professionally work on a complex task and are able to complete a project within a given timeframe, demonstrate the result, and present it.
Students know the current state of the art, present solution concepts, technical setups, developed software, achieved results, and possible extensions.
Students are able to document their work in writing in a scientific report.

Mathematical Optimization
Mathematische Optimierung

Module english / *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Exercise	K, M	None	M.Eng.

Content

- Mathematical modelling
- Formulation/classification of optimisation problems
- Lin. optimisation: graphical solutions, Fourier-Motzkin method, simplex algorithms and their issues with suitable solutions, fundamentals of numerical implementation, basics of sensitivity analysis (parameter dependence)
- Nonlin. optimisation: mathematical foundations, optimisation methods without constraints in R and Rn (including Lagrange formalism, calculus of variations), basic numerical methods

Learning Outcomes

The course teaches the mathematical foundations and selected mathematical methods for model- and data-based improvement of complex technical components, processes, and systems. Participants acquire fundamental knowledge of mathematical modelling, classical and heuristic optimisation. They are able to abstract a technical optimisation task through mathematical models, formulate the corresponding mathematical optimisation problem, and solve and interpret it by appropriately choosing a solution method. Students are specifically able to solve linear optimisation problems graphically, using the Fourier-Motzkin method, and with various simplex algorithms, and to assess the sensitivity of the solutions. They possess practical knowledge of the most important methods of nonlinear optimisation. Students understand the mathematical background and limitations of how optimisation methods work. Additionally, fundamentals of selected numerical methods are taught and applied, primarily in MATLAB.

Modeling and Simulation of Dynamic Systems
Modellierung und Simulation dynamischer Systeme

Module english / *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	4 Lecture	SPA	None	M.Eng.

Content

- Introduction and motivation
- Object-oriented programming
- Object-oriented approaches in OpenModelica
- Description of mathematical models of dynamic processes
- Equation-based modelling
- Modelling of simple mechanical systems
- Modelling of simple electrical systems
- Modelling of energy conversion
- Modelling of complex thermal systems
- Validation and data export

In the lectures, the theoretical foundations are developed, which are then deepened in the exercises using selected, practice-related tasks.

Learning Outcomes

Students have fundamental knowledge of modelling and simulating dynamic systems. They can apply this knowledge independently to simple problems and extend it to complex tasks.

Non-linear Finite Element Analysis

Nichtlineare Finite Elemente Methode

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Laboratory	K, M, SPA	None	M.Eng.

Content

Linear buckling analysis, load stiffness, eigenvalue problem, numerical solution methods (vector iteration)
Nonlinear analysis, Newton-Raphson method, force and displacement control, convergence behaviour
Strain kinematics, displacement interpolation, deformation gradient, polar decomposition, Green and logarithmic strain tensor, plasticity, flow curves, equivalent stresses, kinematic and isotropic hardening, material calibration.

Learning Outcomes

Students know the basic concepts and fundamental equations for dealing with
- large deformations (measures of deformation, strain kinematics, polar decomposition, stress measures)
- plastic material behaviour (yield loci, hardening laws, equivalent plastic strain)
- contact (penalty, Lagrange, master/slave)

They know the limits of applicability of linear and nonlinear models and can assess and justify when nonlinear effects must be considered in a simulation task.
They know numerical methods for determining eigenvalues and eigenvectors (vector iteration) and for solving nonlinear equations (Newton-Raphson) and can apply these methods in FEM programs (ANSYS and CalculiX) for
- assessing the stability of structures
- achieving convergent solutions with large deformations, plasticity, and contact.

Product Cost Calculation and Optimization

Produktkostenkalkulation und Optimierung

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Exercise	K, M, SPA	None	M.Eng.

Content

- Introduction to product cost optimisation
- Relationship between product costs and the economic success of products, companies, and projects
- Structured approach to product cost optimisation (creating transparency, defining targets, developing alternatives)
- Methods (process-based overhead costing, SMART methodology, brainstorming, communication, research, management information design)
- Implementation of optimisation ideas

Learning Outcomes

The student has the ability to systematically determine product costs using process-based overhead costing and to calculate them up to the selling price. They can derive target costs and gain initial knowledge in optimising product costs to meet cost targets.

Environmental Economics

Umweltökonomie

Module english *german*

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	4 Lecture	K	None	M.Eng.

Content

External effects and their internalisation: review and deeper examination of externalities and options for their internalisation according to traditional theoretical concepts of economics
Environmental and climate issues and environmental policy objectives: concise overview of the most relevant environmental problems and their interdependencies with other systems (e.g., socio-economic), national and international environmental policy goals and their restrictions (information deficits, costs, etc.) regarding implementation
Environmental policy instruments: application of theoretical models and strategic concepts for illustrating, discussing, and analysing the efficiency of environmental policy measures (e.g., emissions trading)

Learning Outcomes

Students can describe the characteristics of the commons goods environment/climate. They know the economic modelling approaches to the issue of commons goods. Students can assign practical and conceptualised environmental policy instruments to these models and derive them accordingly. They are able to adopt differentiated perspectives for the critical analysis of individual environmental policy measures, particularly in the global context of environmental issues and climate change.

Material Selection and Design Optimization

Werkstoffauswahl und Bauteiloptimierung

Module
english
german

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	3 Lecture, 1 Exercise	K, SPA	None	M.Eng.

Content

- Material properties, particularly stiffness, strength, toughness, ductility, density, cost
- Material selection using property charts and performance indices
- Notch effect and fundamentals of fracture mechanics
- Sizing and evaluation of composite materials and sandwich structures
- Manufacturing processes and their key attributes. Systematic process selection using databases
- Evaluation of materials and processes regarding sustainability (eco-audit)

Exercise content:
- Material and process selection with CES EduPack
- Finite element analyses, accompanied by analytical calculations using SMath Studio

Learning Outcomes

Students are familiar with the essential mechanical, thermal, and electrical material properties and their significance for design and manufacturing.
They can systematically derive the key criteria for material and process selection from component requirements using databases, and select optimal materials considering cost and lightweight design aspects.
They know how to use Ashby material property charts and are proficient with the software CES EduPack/CES Selector.
They understand the basic approach to sizing and comparing hybrid materials/components (sandwich structures, foams, fibre composites).
Students are able to represent material-relevant physical effects using FEM and check their plausibility with analytical methods.

Economy for Engineers

Wirtschaft für Ingenieure

Module
english
german

Credit points	Teaching and Learning Formats in Contact Hours per Week	Assessment type	Participation Requirements	Overall Qualification
6	2 Lecture, 2 Exercise	K, M, SPA	None	M.Eng.

Content

Introduction to business administration and management: basic principles and concepts; business thinking and action for engineers.
Cost accounting and cost management: types of costs, cost centres and cost units; contribution margin accounting, costing and cost control.
Investment and profitability analysis: methods of investment appraisal (net present value method, annuity method, payback period); evaluation of investment projects.
Financing: fundamentals of financing and corporate finance; forms and instruments of financing; decision-making principles for engineers in the context of corporate finance.
Project management: phases and tools of project management; budgeting, resource and risk management.
Quality management: concepts of quality management; quality assurance in technical processes.
International markets and competition: basics of international business administration; market entry strategies and competitive analysis for technical products.

Learning Outcomes

The module provides fundamental and advanced knowledge of business administration and management. Graduates of this module will be able to recognise and analyse economic challenges in a technical context and make well-founded decisions. Students acquire competencies in the areas of cost accounting, financing, investment appraisal, as well as project and quality management. Additionally, the ability to integrate economic principles and methods into engineering projects and to successfully implement them in global competition is fostered.
After successfully completing the module, students can:
- apply and analyse basic economic concepts and models,
- plan and evaluate technical and economic projects with cost awareness,
- conduct cost-benefit analyses and investment appraisals,
- assess risks and potentials of investment projects,
- evaluate concepts for product and corporate financing,
- understand and apply basic leadership and management tasks.

Scientific Project *Wissenschaftliche Projektarbeit (WPA)*				Module english *german*
Credit points 6	Teaching and Learning Formats in Contact Hours per Week 2 Lecture, 2 Project	Assessment type PE, SPA	Participation Requirements None	Overall Qualification M.Eng.

Content

Students independently work on a freely chosen, practice-oriented topic (internal or external, 1st or 2nd semester) in pairs (exceptions must be discussed with the dean of studies). The specific content arises from the problem statements of company or university projects. The project concludes with a scientific final report and a presentation.
Assessment criteria:
- Task definition (presentation, classification, preparation)
- Literature review (research results, citation style)
- State of the art (traceability, relevance to the task)
- Concept (description, justification)
- Development (presentation, level, substance)
- Results (presentation, reliability)
- Report (timeliness, structure, formal correctness, use of tables and figures)
- Presentation (slide quality, delivery, discussion)
- Poster (message, promotional impact)

Projects can be worked on across semesters; however, participation in both project colloquia with subsequent grading is mandatory.

Learning Outcomes

In independently completing an interdisciplinary project, students deepen their accumulated knowledge—also through exchange with fellow students—and apply it together with their acquired skills. The project work prepares them for the challenges of a master’s thesis. Through teamwork, they further develop their social competence, including conflict resolution skills, ability to cooperate, and communication skills. They understand the advantages of, and overcome the challenges posed by, teamwork. They take responsibility for their actions. Students are able to solve complex problems using methods for generating and evaluating ideas, such as brainstorming, variant discussions, and morphological boxes.
They master methods of strategic project management, such as project planning using project schedules, identifying work packages, and setting milestones. They are capable of independently defining objectives. At the end of the project, students are able to present their results to a specialist or general audience in the form of scientific reports or presentations.

Abbreviations:

Assessment type	
E	Electronic Examination
K	Written Examination
M	Oral Examination
PE	Project Result
SPA	Other Written and Practical Work