



Module Manual

Bachelor of Science (B.Sc.)

Mechatronics Dual study program

Cohort: Winter Term 2022

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Program description

Content

The graduate students of the Bachelor program Mechatronics are able to demonstrate an overview of fundamental knowledge in the fields of material science, production, thermodynamics, mechanical design and computer science. They are able to express in detail basic approaches in the fields of mathematics, mechanics and electrical engineering, to explain the basics of metrology and control theory and to describe the interdisciplinary aspects of Mechatronics. This knowledge and the methods learned enable them to examine problems in Mechatronics, the sub-disciplines of Mechatronics and the adjacent disciplines.

In addition to the foundational curriculum taught at TUHH, seminars on developing personal skills are integrated into the dual study programme, in the context of transfer between theory and practice. These seminars correspond to the modern professional requirements expected of an engineer, as well as promoting the link between the two places of learning.

The intensive dual courses at TUHH integrating practical experience consist of an academic-oriented and a practice-oriented element, which are completed at two places of learning. The academic-oriented element comprises study at TUHH. The practice-oriented element is coordinated with the study programme in terms of content and time, and consists of practical modules and phases spent in an affiliate company during periods when there are no lectures.

Career prospects

The graduates of the Bachelor program Mechatronics are directly able to enter a career in the field of Mechatronics and work responsibly as Engineer. They are entitled to use the professional title Ingenieurin or Ingenieur (Engineer) pursuant to the Engineers Acts (Ingenieurgesetzen) of the states in Germany.

Possible employers include manufacturing companies in mechanical and electrical engineering as well as engineering firms.

The degree allows access to a Master program, for example the consecutive International Master in Mechantronics.

In addition, students acquire basic professional and personal skills as part of the dual study programme that enable them to enter professional practice at an early stage and to go on to further study. Students also gain practical work experience through the integrated practical modules. Graduates of the dual course have broad foundational knowledge, fundamental skills for academic work and relevant personal competences.

Learning target

Graduates are able

- to identify, abstract, formulate and solve technical problems on basic research;
- to select, combine and interdisciplinary apply suitable methods for analysis, modeling, simulation and optimization;
- to understand, analyze and evaluate products and methods in Mechatronics and its sub-disciplines in a systematic manner;
- to apply design methods in Mechatronics;
- to plan and carry out experiments and to interpret their results;
- and to estimate the boundaries of methods and techniques

Graduates can

- interdisciplinarily and responsibly apply and independently expand their knowledge within the sub-disciplines of Mechatronics accounting for economic requirements;
- evaluate Mechatronic problems in a wider societal context and assess the non-technical effects of their engineering work;
- cooperate with experts of other disciplines and laypersons and to communicate in German and English;
- conduct literary research and use databases and other information sources for their work and can express the results of their work understandably both in written and oral presentation;
- expand and deepen their acquired knowledge throughout their lives.

By continually switching places of learnings throughout the dual study programme, it is possible for theory and practice to be interlinked. Students reflect theoretically on their individual professional practical experience, and apply the results of their reflection to new forms of practice. They also test theoretical elements of the course in a practical setting, and use their findings as a stimulus for theoretical debate.

Program structure

The program is split into the core qualifications and Bachelor thesis.

The interdisciplinary final thesis is scheduled for the sixth semester.

At the Hamburg University of Technology the graduates can continue their studies with, among others, the Master program "International Master Mechatronics".

The structural model of the dual study programme follows a module-differentiating approach. Given the practice-oriented element, the curriculum of the dual study programme is different compared to a standard Bachelor's course. Five practical modules are completed at the dual students' partner company as part of corresponding practical terms during lecture-free periods.

Core Qualification

The study of mechatronics enables you to understand interdisciplinary technical issues and to coordinate their solution in project teams and to take on subtasks of each individual technical discipline. This function is often referred to as systems engineering. The core qualifications of the bachelor's degree in mechanical engineering correspond exactly to this requirement and convey the basics from all relevant disciplines (computer science, electrical engineering, mechanics, systems technology) as well as the necessary basics of mathematics.

In addition to the foundational curriculum taught at TUHH, seminars on developing personal skills are integrated into the dual study programme, in the context of transfer between theory and practice. These seminars correspond to the modern professional requirements expected of an engineer, as well as promoting the link between the two places of learning.

The intensive dual courses at TUHH integrating practical experience consist of an academic-oriented and a practice-oriented element, which are completed at two places of learning. The academic-oriented element comprises study at TUHH. The practice-oriented element is coordinated with the study programme in terms of content and time, and consists of practical modules and phases spent in an affiliate company during periods when there are no lectures.

Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields			
Courses			
Title	Typ	Hrs/wk	CP
Electrical Engineering I: Direct Current Networks and Electromagnetic Fields (L0675)	Lecture	3	5
Electrical Engineering I: Direct Current Networks and Electromagnetic Fields (L0676)	Recitation Section (small)	2	1
Module Responsible	Prof. Matthias Kuhl		
Admission Requirements	None		
Recommended Previous Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence <i>Knowledge</i> <i>Skills</i>			
Personal Competence <i>Social Competence</i> <i>Autonomy</i>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	100 Minutes		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory		

Course L0675: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields	
Typ	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	WiSe
Content	
Literature	<ol style="list-style-type: none"> 1. M. Kasper, Skript zur Vorlesung Elektrotechnik 1, 2013 2. M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004 3. F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005 4. A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008

Course L0676: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields	
Typ	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	WiSe
Content	
Literature	<ol style="list-style-type: none"> 1. Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013 2. Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010

Module M0850: Mathematics I				
Courses				
Title		Typ	Hrs/wk	CP
Mathematics I (L2970)		Lecture	4	4
Mathematics I (L2971)		Recitation Section (large)	2	2
Mathematics I (L2972)		Recitation Section (small)	2	2
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	School mathematics			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	<ul style="list-style-type: none"> • Students can name the basic concepts in analysis and linear algebra. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them. <ul style="list-style-type: none"> • Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. <ul style="list-style-type: none"> • Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. <ul style="list-style-type: none"> • Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
<i>Knowledge</i>				
<i>Skills</i>				
Personal Competence				
<i>Social Competence</i>				
<i>Autonomy</i>				
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Course achievement	Compulsory	Bonus	Form	Description
	Yes	10 %	Excercises	
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory			

Course L2970: Mathematics I	
Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	WiSe
Content	<p>Mathematical Foundations:</p> <p>sets, statements, induction, mappings, trigonometry</p> <p>Analysis: Foundations of differential calculus in one variable</p> <ul style="list-style-type: none"> • natural and real numbers • convergence of sequences and series • continuous and differentiable functions • mean value theorems • Taylor series • calculus • error analysis • fixpoint iteration <p>Linear Algebra: Foundations of linear algebra in \mathbb{R}^n</p> <ul style="list-style-type: none"> • vectors: rules, linear combinations, inner and cross product, lines and planes • systems of linear equations: Gauß elimination, linear mappings, matrix multiplication, inverse matrices, determinants • orthogonal projection in \mathbb{R}^n, Gram-Schmidt-Orthonormalization
Literature	<ul style="list-style-type: none"> • T. Arens u.a. : Mathematik, Springer Spektrum, Heidelberg 2015 • W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 • W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 • G. Strang: Lineare Algebra, Springer-Verlag, 2003 • G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013

Course L2971: Mathematics I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Dr. Dennis Clemens, Dr. Simon Campese
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2972: Mathematics I	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0933: Fundamentals of Materials Science				
Courses				
Title		Typ	Hrs/wk	CP
Fundamentals of Materials Science I (L1085)		Lecture	2	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture	2	2
Physical and Chemical Basics of Materials Science (L1095)		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
<i>Knowledge</i>	The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.			
<i>Skills</i>	The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.			
Personal Competence				
<i>Social Competence</i>	-			
<i>Autonomy</i>	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory Data Science: Specialisation II. Application: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory			

Course L1085: Fundamentals of Materials Science I	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 P. Haasen: Physikalische Metallkunde. Springer 1994

Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider
Language	DE
Cycle	SoSe
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course L1095: Physical and Chemical Basics of Materials Science	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Gregor Vonbun-Feldbauer
Language	DE
Cycle	WiSe
Content	<ul style="list-style-type: none"> • Motivation: „Atoms in Mechanical Engineering?“ • Basics: Force and Energy • The electromagnetic Interaction • „Detour“: Mathematics (complex e-funktion etc.) • The atom: Bohr's model of the atom • Chemical bounds • The multi part problem: Solutions and strategies • Descriptions of using statistical thermodynamics • Elastic theory of atoms • Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	<p>Für den Elektromagnetismus:</p> <ul style="list-style-type: none"> • Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter <p>Für die Atomphysik:</p> <ul style="list-style-type: none"> • Haken, Wolf: „Atom- und Quantenphysik“, Springer <p>Für die Materialphysik und Elastizität:</p> <ul style="list-style-type: none"> • Hornbogen, Warlimont: „Metallkunde“, Springer

Module M1692: Computer Science for Engineers - Introduction and Overview				
Courses				
Title		Typ	Hrs/wk	CP
Computer Science for Engineers - Introduction and Overview (L2685)		Lecture	3	3
Computer Science for Engineers - Introduction and Overview (L2686)		Recitation Section (small)	2	3
Module Responsible	Prof. Görschwin Fey			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence <i>Knowledge</i> <i>Skills</i>				
Personal Competence <i>Social Competence</i> <i>Autonomy</i>				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	No	10 %	Attestation	Testate finden semesterbegleitend statt.
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory			

Course L2685: Computer Science for Engineers - Introduction and Overview	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Görschwin Fey
Language	DE/EN
Cycle	WiSe
Content	
Literature	<ul style="list-style-type: none"> • Informatik <ul style="list-style-type: none"> ◦ Helmut Herold, Bruno Lurz, Jürgen Wohlrab, Matthias Hopf: Grundlagen der Informatik, 3. Auflage, 816 Seiten, Pearson Studium, 2017. • C++ <ul style="list-style-type: none"> ◦ Bjarne Stroustrup, Einführung in die Programmierung mit C++, 479 Seiten, Pearson Studium, 2010. --> in der englischen Version bereits eine neuere Auflage! ◦ Jürgen Wolf : Grundkurs C++: C++-Programmierung verständlich erklärt, Rheinwerk Computing, 3. Auflage, 2016.

Course L2686: Computer Science for Engineers - Introduction and Overview	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Görschwin Fey
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1802: Engineering Mechanics I (Stereostatics)			
Courses			
Title		Typ	Hrs/wk
Engineering Mechanics I (Statics) (L1001)		Lecture	2
Engineering Mechanics I (Statics) (L1003)		Recitation Section (large)	1
Engineering Mechanics I (Statics) (L1002)		Recitation Section (small)	2
Module Responsible	Prof. Benedikt Kriegesmann		
Admission Requirements	None		
Recommended Previous Knowledge	Solid school knowledge in mathematics and physics.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	The students can <ul style="list-style-type: none"> describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge in stereostatics. 		
<i>Skills</i>	The students can <ul style="list-style-type: none"> explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic statical methods to engineering problems; estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. 		
Personal Competence			
<i>Social Competence</i>	The students can work in groups and support each other to overcome difficulties.		
<i>Autonomy</i>	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L1001: Engineering Mechanics I (Statics)	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	<ul style="list-style-type: none"> • Tasks in Mechanics • Modelling and model elements • Vector calculus for forces and torques • Forces and equilibrium in space • Constraints and reactions, characterization of constraint systems • Planar and spatial truss structures • Internal forces and moments for beams and frames • Center of mass, volumn, area and line • Computation of center of mass by intergals, joint bodies • Friction (sliding and sticking) • Friction of ropes
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Course L1003: Engineering Mechanics I (Statics)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Course L1002: Engineering Mechanics I (Statics)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Module M1755: Linking theory and practice (dual study program, Bachelor's degree)	
Module Responsible	Dr. Henning Haschke
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence <i>Knowledge</i>	Dual students... ... can describe and classify selected classic and modern theories, concepts and methods <ul style="list-style-type: none"> • related to self-management, and organising work and learning • self-competence and • social skills ... and apply them to specific situations, projects and plans in a personal and professional context.
<i>Skills</i>	Dual students... <ul style="list-style-type: none"> • ... anticipate typical difficulties, positive and negative effects, as well as success and failure factors in the engineering sector, evaluate them and consider promising strategies and courses of action.
Personal Competence <i>Social Competence</i>	Dual students... <ul style="list-style-type: none"> • ... work together in a problem-oriented and interdisciplinary manner as part of expert and work teams. • ... are able to assemble and lead working groups. • ... present complex, subject-related solutions to problems to experts and stakeholders and can develop these further together.
<i>Autonomy</i>	Dual students... <ul style="list-style-type: none"> • ... define, reflect and evaluate goals for learning and work processes. • ... design their learning and work processes independently and sustainably at the university and company. • ... take responsibility for their learning and work processes. • ... are able to consciously think through their ideas or actions and relate them to their self-image to develop conclusions for future action based on this.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Studienbegleitende und semesterübergreifende Dokumentation: Die Leistungspunkte für das Modul werden durch die Anfertigung eines digitalen Lern- und Entwicklungsberichtes (E-Portfolio) erworben. Dabei handelt es sich um eine fortlaufende Dokumentation und Reflexion der Lernerfahrungen und der Kompetenzentwicklung im Bereich der Personalen Kompetenz.

Course L2885: Self-Competence for Professional Success in Engineering (for Dual Study Program)	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Henning Haschke, Heiko Sieben
Language	DE
Cycle	WiSe/SoSe
Content	<ul style="list-style-type: none"> • Key qualifications for professional success • Personality and self-image • Personality profiles • Emotional competence • Needs structure models • Motivation theories and models • Communication basics, communication problems • Conflict management • Constructive communication and language cultures • Resilience • Transfer skills and (self-)reflection • Intercultural competence and business etiquette • Documenting and reflecting on learning experiences
Literature	Seminarapparat

Course L2884: Self-Management, Organising Work and Learning in Engineering (for Dual Study Program)	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Henning Haschke, Heiko Sieben
Language	DE
Cycle	WiSe/SoSe
Content	<ul style="list-style-type: none"> • Learning to learn • Instruments and methods for time and self-management • Personality and work style/behaviour (DISC model); inner drivers/motivation • Goal setting and planning techniques (SMART, GROW); for short-, medium- and long-term planning • Creativity techniques • Stress management, resilience • (Self-)reflection throughout the learning and work process • Structuring/connecting learning and work processes within different learning environments • Factors influencing learning transfer/transfer skills • Documenting and reflecting on learning experiences
Literature	Seminarapparat

Course L2886: Social-Competence: Team Development and Communication in Engineering (for Dual Study Program)	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Henning Haschke, Heiko Sieben
Language	DE
Cycle	WiSe/SoSe
Content	<ul style="list-style-type: none"> • Forms, conditions and processes of working groups and leadership relationships • Social skills: theories and models • Communication and discussion techniques • Empathy and motivation in teamwork, the way teams work • Critical ability • Team development: ways of developing working and project groups • Insights into day-to-day leadership: theories and models, leadership tasks, leadership styles, situational leadership, basics of change management • Documenting and reflecting on learning experiences
Literature	Seminarapparat

Module M1750: Practical module 1 (dual study program, Bachelor's degree)			
Courses			
Title	Typ	Hrs/wk	CP
Practical term 1 (dual study program, Bachelor's degree) (L2879)		0	6
Module Responsible	Dr. Henning Haschke		
Admission Requirements	None		
Recommended Previous Knowledge	A: Self-management, organising work and learning in engineering (for dual study program)		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Dual students... <ul style="list-style-type: none"> ... describe their employer's organisation (company) and the associated regulations that relate to how tasks and competences are distributed, as well as how work processes are handled. ... understand the structure and objectives of the dual study programme and the increasing requirements throughout the course of study. 		
<i>Skills</i>	Dual students... <ul style="list-style-type: none"> ... use equipment and resources professionally in accordance with the assigned work areas and tasks, and describe operational processes and procedures with regard to the intended work results/objectives. ... implement the university's application recommendations in relation to their current tasks. 		
Personal Competence			
<i>Social Competence</i>	Dual students... <ul style="list-style-type: none"> ... have familiarised themselves with their new working environment (learning environment) and the associated tasks/processes/working relationships. ... know their central points of contact and company colleagues, and exchange ideas with them constructively. ... coordinate work tasks with their professional supervisor and ask for support as needed. ... help shape the work in the assigned work area and offer their colleagues support to complete their work. ... work together with others in smaller work teams in a result-oriented manner. 		
<i>Autonomy</i>	Dual students... <ul style="list-style-type: none"> ... structure their work and learning processes within the company independently in line with their responsibilities and authorisations, and coordinate them with their professional supervisor. ... complete work tasks/assignments with the support of colleagues. ... coordinate the practical phase with any individual preparation required for the examination phase at TUHH. ... document and reflect on how their foundational subjects link with their work as an engineer. 		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and scale	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L2879: Practical term 1 (dual study program, Bachelor's degree)	
Typ	
Hrs/wk	0
CP	6
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Lecturer	Dr. Henning Haschke
Language	DE
Cycle	WiSe
Content	<p>Company onboarding process</p> <ul style="list-style-type: none"> • Assigning initial work areas (supervisor, colleagues) • Assigning a contact person within the company (usually the HR department) • Assigning a professional mentor in the work area (relating to practical application) • Responsibilities and authorisations of the dual student within the company • Supporting/working with colleagues • Scheduling the relevant practical modules with initial work tasks • Theory/practice transfer options • Scheduling the examination phase/subsequent study semester <p>Operational knowledge and skills</p> <ul style="list-style-type: none"> • Company-specific: organisational structure, corporate strategy, business and work areas, work procedures and processes, operational levels • Process and procedure options within the labour-market-relevant field of engineering • Operational equipment and resources • Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company <p>Sharing/reflecting on learning</p> <ul style="list-style-type: none"> • Creating an e-portfolio • Relevance of foundational subjects when working as an engineer • Comparing the learning and working processes of different learning environments with regard to their results and effects
Literature	<ul style="list-style-type: none"> • Studierendenhandbuch • Betriebliche Dokumente • Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer

Module M0547: Electrical Engineering II: Alternating Current Networks and Basic Devices				
Courses				
Title		Typ	Hrs/wk	CP
Electrical Engineering II: Alternating Current Networks and Basic Devices (L0178)		Lecture	3	5
Electrical Engineering II: Alternating Current Networks and Basic Devices (L0179)		Recitation Section (small)	2	1
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I Mathematics I Direct current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	<p><i>Knowledge</i> Students are able to reproduce and explain fundamental theories, principles, and methods related to the theory of alternating currents. They can describe networks of linear elements using a complex notation for voltages and currents. They can reproduce an overview of applications for the theory of alternating currents in the area of electrical engineering. Students are capable of explaining the behavior of fundamental passive and active devices as well as their impact on simple circuits.</p> <p><i>Skills</i> Students are capable of calculating parameters within simple electrical networks at alternating currents by means of a complex notation for voltages and currents. They can appraise the fundamental effects that may occur within electrical networks at alternating currents. Students are able to analyze simple circuits such as oscillating circuits, filter, and matching networks quantitatively and dimension elements by means of a design. They can motivate and justify the fundamental elements of an electrical power supply (transformer, transmission line, compensation of reactive power, multiphase system) and are qualified to dimension their main features.</p> <p>Personal Competence</p> <p><i>Social Competence</i> Students are able to work together on subject related tasks in small groups. They are able to present their results effectively.</p> <p><i>Autonomy</i> Students are capable to gather necessary information from the references provided and relate that information to the context of the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as online-tests and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between their knowledge obtained in this lecture and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis).</p>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	No	10 %	Midterm	
Examination	Written exam			
Examination duration and scale	90 - 150 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory			

Course L0178: Electrical Engineering II: Alternating Current Networks and Basic Devices	
Typ	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> - General time-dependency of electrical networks - Representation and properties of harmonic signals - RLC-elements at alternating currents/voltages - Complex notation for the representation of RLC-elements - Power in electrical networks at alternating currents, compensation of reactive power - Frequency response locus (Nyquist plot) and Bode-diagrams - Measurement instrumentation for assessing alternating currents - Oscillating circuits, filters, electrical transmission lines - Transformers, three-phase current, energy converters - Simple non-linear and active electrical devices
Literature	<ul style="list-style-type: none"> - M. Albach, "Elektrotechnik", Pearson Studium (2011) - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) - R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010) - C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009) - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013) - R. Dorf, "The Electrical Engineering Handbook", CRC (2006)

Course L0179: Electrical Engineering II: Alternating Current Networks and Basic Devices	
Typ	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> - General time-dependency of electrical networks - Representation and properties of harmonic signals - RLC-elements at alternating currents/voltages - Complex notation for the representation of RLC-elements - Power in electrical networks at alternating currents, compensation of reactive power - Frequency response locus (Nyquist plot) and Bode-diagrams - Measurement instrumentation for assessing alternating currents - Oscillating circuits, filters, electrical transmission lines - Transformers, three-phase current, energy converters - Simple non-linear and active electrical devices
Literature	<ul style="list-style-type: none"> - M. Albach, "Elektrotechnik", Pearson Studium (2011) - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) - R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010) - C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009) - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013) - R. Dorf, "The Electrical Engineering Handbook", CRC (2006)

Module M0594: Fundamentals of Mechanical Engineering Design			
Courses			
Title	Typ	Hrs/wk	CP
Fundamentals of Mechanical Engineering Design (L0258)	Lecture	2	3
Fundamentals of Mechanical Engineering Design (L0259)	Recitation Section (large)	2	3
Module Responsible	Prof. Dieter Krause		
Admission Requirements	None		
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Basic knowledge about mechanics and production engineering • Internship (Stage I Practical) 		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<p><i>Knowledge</i></p> <p>After passing the module, students are able to:</p> <ul style="list-style-type: none"> • explain basic working principles and functions of machine elements, • explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations. <p><i>Skills</i></p> <p>After passing the module, students are able to:</p> <ul style="list-style-type: none"> • accomplish dimensioning calculations of covered machine elements, • transfer knowledge learned in the module to new requirements and tasks (problem solving skills), • recognize the content of technical drawings and schematic sketches, • technically evaluate basic designs. <p>Personal Competence</p> <p><i>Social Competence</i></p> <ul style="list-style-type: none"> • Students are able to discuss technical information in the lecture supported by activating methods. <p><i>Autonomy</i></p> <ul style="list-style-type: none"> • Students are able to independently deepen their acquired knowledge in exercises. • Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	120		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L0258: Fundamentals of Mechanical Engineering Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	<p>Lecture</p> <ul style="list-style-type: none"> • Introduction to design • Introduction to the following machine elements <ul style="list-style-type: none"> ◦ Screws ◦ Shaft-hub joints ◦ Rolling contact bearings ◦ Welding / adhesive / solder joints ◦ Springs ◦ Axes & shafts • Presentation of technical objects (technical drawing) <p>Exercise</p> <ul style="list-style-type: none"> • Calculation methods for dimensioning the following machine elements: <ul style="list-style-type: none"> ◦ Screws ◦ Shaft-hub joints ◦ Rolling contact bearings ◦ Welding / adhesive / solder joints ◦ Springs ◦ Axis & shafts
Literature	<ul style="list-style-type: none"> • Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. • Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. • Sowie weitere Bücher zu speziellen Themen

Course L0259: Fundamentals of Mechanical Engineering Design	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0851: Mathematics II				
Courses				
Title		Typ	Hrs/wk	CP
Mathematics II (L2976)		Lecture	4	4
Mathematics II (L2977)		Recitation Section (large)	2	2
Mathematics II (L2978)		Recitation Section (small)	2	2
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	<ul style="list-style-type: none"> Students can name further concepts in analysis and linear algebra. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. <ul style="list-style-type: none"> Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. <ul style="list-style-type: none"> Students are able to work together in teams. They are capable to use mathematics as a common language. In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. <ul style="list-style-type: none"> Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
<i>Knowledge</i>				
<i>Skills</i>				
Personal Competence				
<i>Social Competence</i>				
<i>Autonomy</i>				
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Course achievement	Compulsory	Bonus	Form	Description
	Yes	10 %	Excercises	
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory			

Course L2976: Mathematics II	
Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2977: Mathematics II	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2978: Mathematics II	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1693: Computer Science for Engineers - Programming Concepts, Data Handling & Communication				
Courses				
Title		Typ	Hrs/wk	CP
Computer Science for Engineers - Programming Concepts, Data Handling & Communication (L2689)		Lecture	3	3
Computer Science for Engineers - Programming Concepts, Data Handling & Communication (L2690)		Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence <i>Knowledge</i> <i>Skills</i>				
Personal Competence <i>Social Competence</i> <i>Autonomy</i>				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	No	10 %	Attestation	Testate finden semesterbegleitend statt.
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies, Focus Renewable Energy: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Systems: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechatronics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory			

Course L2689: Computer Science for Engineers - Programming Concepts, Data Handling & Communication	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Sibylle Fröschle
Language	DE
Cycle	SoSe
Content	
Literature	John V. Guttag: Introduction to Computation and Programming Using Python. With Application to Understanding Data. 2nd Edition. The MIT Press, 2016.

Course L2690: Computer Science for Engineers - Programming Concepts, Data Handling & Communication	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sibylle Fröschle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1803: Engineering Mechanics II (Elastostatics)			
Courses			
Title	Typ	Hrs/wk	CP
Engineering Mechanics II (Elastostatics) (L0493)	Lecture	2	2
Engineering Mechanics II (Elastostatics) (L1691)	Recitation Section (large)	2	2
Engineering Mechanics II (Elastostatics) (L0494)	Recitation Section (small)	2	2
Module Responsible	Prof. Christian Cyron		
Admission Requirements	None		
Recommended Previous Knowledge	Engineering Mechanics I, Mathematics I (basic knowledge of rigid body mechanics such as balance of linear and angular momentum, basic knowledge of linear algebra like vector-matrix calculus, basic knowledge of analysis such as differential and integral calculus)		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	Having accomplished this module, the students know and understand the basic concepts of continuum mechanics and elastostatics, in particular stress, strain, constitutive laws, stretching, bending, torsion, failure analysis, energy methods and stability of structures.		
<i>Knowledge</i>			
<i>Skills</i>	Having accomplished this module, the students are able to - apply the fundamental concepts of mathematical and mechanical modeling and analysis to problems of their choice - apply the basic methods of elastostatics to problems of engineering, in particular in the design of mechanical structures - to educate themselves about more advanced aspects of elastostatics		
Personal Competence	Ability to communicate complex problems in elastostatics, to work out solution to these problems together with others, and to communicate these solutions		
<i>Social Competence</i>			
<i>Autonomy</i>	self-discipline and endurance in tackling independently complex challenges in elastostatics; ability to learn also very abstract knowledge		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L0493: Engineering Mechanics II (Elastostatics)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	<p>The lecture Engineering Mechanics II introduces the fundamental concepts of stress and strain and explains how these can be used to characterize and compute elastic deformations of mechanical bodies under loading. The focus of the lecture lies on:</p> <ul style="list-style-type: none"> • basis of continuum mechanics: stress, strain, constitutive laws • truss • torsion bar • beam theory: bending, moment of inertia of area, transverse shear • energy methods: Maxwell-Betti reciprocal work theorem, Castigliano's second theorem, theorem of Menabrea • strength of materials: maximum principle stress criterion, yield criteria according to Tresca and von Mises • stability of mechanical structures: Euler buckling strut
Literature	<ul style="list-style-type: none"> • Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer • Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer

Course L1691: Engineering Mechanics II (Elastostatics)	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron, Dr. Konrad Schneider
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0494: Engineering Mechanics II (Elastostatics)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1751: Practical module 2 (dual study program, Bachelor's degree)			
Courses			
Title	Typ	Hrs/wk	CP
Practical term 2 (dual study program, Bachelor's degree) (L2880)		0	6
Module Responsible	Dr. Henning Haschke		
Admission Requirements	None		
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Successful completion of practical module 1 as part of the dual Bachelor's course • course A from the module on interlinking theory and practice as part of the dual Bachelor's course 		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Dual students ... <ul style="list-style-type: none"> • ... describe their employer's organisational structure (company) and differentiate between associated regulations that relate to how tasks and competences are distributed, as well as how work processes are handled. • ... understand the structure and objectives of the dual study programme and the increasing requirements throughout the course of study. 		
<i>Skills</i>	Dual students ... <ul style="list-style-type: none"> • ... use equipment and resources professionally in accordance with the assigned work areas and tasks, and assess operational processes and procedures with regard to the intended work results/objectives. • ... implement the university's application recommendations in relation to their current tasks. 		
Personal Competence			
<i>Social Competence</i>	Dual students ... <ul style="list-style-type: none"> • ... have familiarised themselves with their new working environment (learning environment) and the associated tasks/processes/working relationships. • ... know their central points of contact and colleagues, and are integrated into the designated tasks and work areas. • ... coordinate work tasks with their professional supervisor and justify procedures and intended results. • ... help shape the work in the assigned work area and offer their colleagues support to complete their work or ask for support based on their needs. • ... work together with others in interdisciplinary work teams in a result-oriented manner. 		
<i>Autonomy</i>	Dual students ... <ul style="list-style-type: none"> • ... structure their work and learning processes within the company independently in line with their responsibilities and authorisations, and coordinate them with their professional supervisor. • ... complete work tasks/assignments independently and/or with the support of colleagues. • ... coordinate the practical phase with any individual preparation required for the examination phase at TUHH. • ... document and reflect on how their foundational subjects link with their work as an engineer. 		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and scale	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L2880: Practical term 2 (dual study program, Bachelor's degree)	
Typ	
Hrs/wk	0
CP	6
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Lecturer	Dr. Henning Haschke
Language	DE
Cycle	SoSe
Content	<p>Company onboarding process</p> <ul style="list-style-type: none"> • Assigning work areas (supervisor, colleagues) • Assigning a contact person within the company (usually the HR department) • Assigning a professional mentor in the work area (relating to practical application) • Responsibilities and authorisations of the dual student within the company • Supporting/working with colleagues • Scheduling the relevant practical modules with work tasks • Theory/practice transfer options • Scheduling the examination phase/subsequent study semester <p>Operational knowledge and skills</p> <ul style="list-style-type: none"> • Company-specific: organisational structure, corporate strategy, business and work areas, work procedures and processes, operational levels • Process and procedure options within the labour-market-relevant field of engineering • Operational equipment and resources • Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company <p>Sharing/reflecting on learning</p> <ul style="list-style-type: none"> • Creating an e-portfolio • Relevance of foundational subjects when working as an engineer • Comparing the learning and working processes of different learning environments with regard to their results and effects
Literature	<ul style="list-style-type: none"> • Studierendenhandbuch • Betriebliche Dokumente • Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer

Module M0598: Mechanical Engineering: Design				
Courses				
Title		Typ	Hrs/wk	CP
Embodiment Design and 3D-CAD Introduction and Practical Training (L0268)		Lecture	2	1
Mechanical Design Project I (L0695)		Project-/problem-based Learning	3	2
Mechanical Design Project II (L0592)		Project-/problem-based Learning	3	2
Team Project Design Methodology (L0267)		Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Fundamentals of Mechanical Engineering Design • Mechanics • Fundamentals of Materials Science • Production Engineering 			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	<p><i>Knowledge</i> After passing the module, students are able to:</p> <ul style="list-style-type: none"> • explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, • describe basics of 3D CAD, • explain basics methods of engineering designing. <p><i>Skills</i> After passing the module, students are able to:</p> <ul style="list-style-type: none"> • independently create sketches, technical drawings and documentations e.g. using 3D CAD, • design components based on design guidelines autonomously, • dimension (calculate) used components, • use methods to design and solve engineering design tasks systematically and solution-oriented, • apply creativity techniques in teams. <p>Personal Competence</p> <p><i>Social Competence</i> After passing the module, students are able to:</p> <ul style="list-style-type: none"> • develop and evaluate solutions in groups including making and documenting decisions, • moderate the use of scientific methods, • present and discuss solutions and technical drawings within groups, • reflect the own results in the work groups of the course. <p><i>Autonomy</i> Students are able</p> <ul style="list-style-type: none"> • to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), • To solve engineering design tasks systematically. 			
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	Yes	None	Written elaboration	Konstruktionsprojekt 1
	Yes	None	Written elaboration	Konstruktionsprojekt 2
	Yes	None	Written elaboration	3D-CAD-Praktikum
	Yes	None	Written elaboration	Teamprojekt Konstruktionsmethodik
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory			

Course L0268: Embodiment Design and 3D-CAD Introduction and Practical Training	
Typ	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	<ul style="list-style-type: none"> • Basics of 3D CAD technology • Practical course to apply a 3D CAD system <ul style="list-style-type: none"> ◦ Introduction to the system ◦ Sketching and creation of components ◦ Creation of assemblies ◦ Deriving technical drawings
Literature	<ul style="list-style-type: none"> • CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. • Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. • Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. • Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. • Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Vošiek, J., Springer Vieweg, aktuelle Auflage.

Course L0695: Mechanical Design Project I	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	<ul style="list-style-type: none"> • Create a technical documentation of an existing mechanical model • Consolidation of the following aspects of technical drawings: <ul style="list-style-type: none"> ◦ Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) ◦ Sectional views ◦ Dimensioning ◦ Tolerances and surface specifications ◦ Creating a tally sheet
Literature	<ol style="list-style-type: none"> 1. Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. 2. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. 3. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.

Course L0592: Mechanical Design Project II	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Jan Hendrik Dege
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Generation of sketches for functions and sub-functions • Approximately calculation of shafts • Dimension of bearings, screw connections and weld • Generation of engineering drawings (assembly drawings, manufacturing drawing)
Literature	<p>Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, K.-H., Springer-Verlag.</p> <p>Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.</p> <p>Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.</p> <p>Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.</p> <p>Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.</p>

Course L0267: Team Project Design Methodology	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Introduction to engineering designing methodology • Team Project Design Methodology <ul style="list-style-type: none"> ◦ Creating requirement lists ◦ Problem formulation ◦ Creating functional structures ◦ Finding solutions ◦ Evaluation of the found concepts ◦ Documentation of the taken methodological steps and the concepts using presentation slides
Literature	<ul style="list-style-type: none"> • Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. • Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. • Sowie weitere Bücher zu speziellen Themen

Module M0853: Mathematics III				
Courses				
Title	Typ	Hrs/wk	CP	
Analysis III (L1028)	Lecture	2	2	
Analysis III (L1029)	Recitation Section (small)	1	1	
Analysis III (L1030)	Recitation Section (large)	1	1	
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2	
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation Section (small)	1	1	
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation Section (large)	1	1	
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I + II			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
<i>Knowledge</i>	<ul style="list-style-type: none"> • Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them. 			
<i>Skills</i>	<ul style="list-style-type: none"> • Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. 			
Personal Competence				
<i>Social Competence</i>	<ul style="list-style-type: none"> • Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. 			
<i>Autonomy</i>	<ul style="list-style-type: none"> • Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations 1)			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory			

Course L1028: Analysis III	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	<p>Main features of differential and integrational calculus of several variables</p> <ul style="list-style-type: none"> • Differential calculus for several variables • Mean value theorems and Taylor's theorem • Maximum and minimum values • Implicit functions • Minimization under equality constraints • Newton's method for multiple variables • Fourier series • Double integrals over general regions • Line and surface integrals • Theorems of Gauß and Stokes
Literature	<ul style="list-style-type: none"> • http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis III	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1030: Analysis III	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1031: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	<p>Main features of the theory and numerical treatment of ordinary differential equations</p> <ul style="list-style-type: none"> • Introduction and elementary methods • Existence and uniqueness of initial value problems • Linear differential equations • Stability and qualitative behaviour of the solution • Boundary value problems and basic concepts of calculus of variations • Eigenvalue problems • Numerical methods for the integration of initial and boundary value problems • Classification of partial differential equations
Literature	<ul style="list-style-type: none"> • http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1033: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1752: Practical module 3 (dual study program, Bachelor's degree)			
Courses			
Title	Typ	Hrs/wk	CP
Practical term 3 (dual study program, Bachelor's degree) (L2881)			
Module Responsible	Dr. Henning Haschke		
Admission Requirements	None		
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Successful completion of practical module 2 as part of the dual Bachelor's course • course B from the module on interlinking theory and practice as part of the dual Bachelor's course 		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Dual students ... <ul style="list-style-type: none"> • ... understand the company's strategic orientation, as well as the functions and organisation of central departments with their decision-making structures, network relationships. • ... understand the requirements of the engineering profession and correctly estimate the resulting responsibility. • ... combine their knowledge of facts, principles, theories and methods gained from previous study content with acquired practical knowledge - in particular their knowledge of practical professional procedures and approaches, in the current field of activity. 		
<i>Skills</i>	Dual students ... <ul style="list-style-type: none"> • ... apply technical theoretical knowledge to current problems in their own area of work, and evaluate work processes and results. • ... use technology, equipment and resources in accordance with the assigned work areas and tasks, and assess operational processes and procedures with regard to the intended work results/objectives. • ... implement the university's application recommendations in relation to their current tasks. 		
Personal Competence			
<i>Social Competence</i>	Dual students ... <ul style="list-style-type: none"> • ... plan work processes cooperatively, including across work areas. • ... communicate professionally with operational stakeholders and present complex issues in a structured, targeted and convincing manner. 		
<i>Autonomy</i>	Dual students ... <ul style="list-style-type: none"> • ... assume responsibility for work assignments and areas. • ... document and reflect on the relevance of subject modules and specialisations for work as an engineer, as well as the implementation of the university's application recommendations and the associated challenges of a positive transfer of knowledge between theory and practice. 		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and scale	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L2881: Practical term 3 (dual study program, Bachelor's degree)	
Typ	
Hrs/wk	0
CP	6
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Lecturer	Dr. Henning Haschke
Language	DE
Cycle	WiSe
Content	<p>Company onboarding process</p> <ul style="list-style-type: none"> • Assigning work area(s) • Extending responsibilities and authorisations of the dual student within the company • Independent work tasks and areas • Participating in project teams • Scheduling the relevant practical modules with work tasks • Theory/practice transfer options • Scheduling the examination phase/subsequent study semester <p>Operational knowledge and skills</p> <ul style="list-style-type: none"> • Company-specific: strategic direction, organisation of central business and work areas, departments, decision-making structures, network relationships and internal communication • Linking facts, principles and theories with practical knowledge • Process and procedure options within the labour-market-relevant field of engineering • Operational technology, equipment and resources • Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company <p>Sharing/reflecting on learning</p> <ul style="list-style-type: none"> • E-portfolio • Relevance of subject modules and specialisations when working as an engineer • University application recommendations for transferring knowledge between theory and practice
Literature	<ul style="list-style-type: none"> • Studierendenhandbuch • Betriebliche Dokumente • Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer

Module M0708: Electrical Engineering III: Circuit Theory and Transients			
Courses			
Title		Typ	Hrs/wk CP
Circuit Theory (L0566)		Lecture	3 4
Circuit Theory (L0567)		Recitation Section (small)	2 2
Module Responsible	Prof. Alexander Kölpin		
Admission Requirements	None		
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and II		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Students are able to explain the basic methods for calculating electrical circuits. They know the Fourier series analysis of linear networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.		
<i>Skills</i>	The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.		
Personal Competence			
<i>Social Competence</i>	Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within the group.		
<i>Autonomy</i>	The students are able to find out the required methods for solving the given practice problems. Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	150 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Electrical Engineering: Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Mechatronics: Specialisation Electrical Systems: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L0566: Circuit Theory	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Kölpin, Dr. Fabian Lurz
Language	DE
Cycle	WiSe
Content	<ul style="list-style-type: none"> - Circuit theorems - N-port circuits - Periodic excitation of linear circuits - Transient analysis in time domain - Transient analysis in frequency domain; Laplace Transform - Frequency behaviour of passive one-ports
Literature	<ul style="list-style-type: none"> - M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011) - M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011) - L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011) - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) - R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006) - L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

Course L0567: Circuit Theory	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Kölpin, Dr. Fabian Lurz
Language	DE
Cycle	WiSe
Content	see interlocking course
Literature	siehe korrespondierende Lehrveranstaltung

Module M1804: Engineering Mechanics III (Dynamics)			
Courses			
Title	Typ	Hrs/wk	CP
Engineering Mechanics III (Dynamics) (L1134)	Lecture	3	3
Engineering Mechanics III (Dynamics) (L1136)	Recitation Section (large)	1	1
Engineering Mechanics III (Dynamics) (L1135)	Recitation Section (small)	2	2
Module Responsible	Prof. Robert Seifried		
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I, II, Engineering Mechanics I (Statics). Parallel to Engineering Mechanik III the module Mathematics III should be attended.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	The students can <ul style="list-style-type: none"> describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge in kinematics, kinetics and vibrations. 		
<i>Skills</i>	The students can <ul style="list-style-type: none"> explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic kinematic, kinetic and vibraton methods to engineering problems; estimate the reach and boundaries of kinematic, kinetic and vibraton methods and extend them to be applicable to wider problem sets. 		
Personal Competence			
<i>Social Competence</i>	The students can work in groups and support each other to overcome difficulties.		
<i>Autonomy</i>	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Course achievement	Compulsory	Bonus	Form
	No	20 %	Midterm
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L1134: Engineering Mechanics III (Dynamics)	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	Kinematics 1.1 Motion of a particle 1.2 Planar motion of a rigid body 1.3 Spatial motion of a rigid body 1.4 Spatial relative Kinematics 2 Kinetics 2.1 Linear momentum and change of linear momentum 2.2 Angular momentum and change of angular momentum 2.3 Kinetics of rigid bodies 2.4 Energy and balance of energy 3 Vibrations 3.1 Classification of Vibrations 3.2 Free undamped vibration 3.3 Free damped vibration 3.4 Forced vibration 4. Impact problems 5 Kinetics of gyroscopes 5.1 Free gyroscopic motion 5.2 Forced gyroscopic motion
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3 und 4. 11. Auflage, Springer (2011).

Course L1136: Engineering Mechanics III (Dynamics)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1135: Engineering Mechanics III (Dynamics)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0672: Signals and Systems			
Courses			
Title		Typ	Hrs/wk
Signals and Systems (L0432)		Lecture	3
Signals and Systems (L0433)		Recitation Section (small)	2
Module Responsible	Prof. Gerhard Bauch		
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics 1-3		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not required.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<p><i>Knowledge</i> The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.</p> <p>The students are familiar with the contents of lecture and tutorials. They can explain and apply them to new problems.</p> <p><i>Skills</i> The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc.. They can assess the impact of LTI systems on the signal properties in time and frequency domain.</p> <p>Personal Competence</p> <p><i>Social Competence</i> The students can jointly solve specific problems.</p> <p><i>Autonomy</i> The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.</p>		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L0432: Signals and Systems	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Introduction to signal and system theory • Signals <ul style="list-style-type: none"> ◦ Classification of signals <ul style="list-style-type: none"> ▪ Continuous-time and discrete-time signals ▪ Analog and digital signals ▪ Deterministic and random signals ◦ Description of LTI systems by differential equations or difference equations, respectively ◦ Basic properties of signals and operations on signals ◦ Elementary signals ◦ Distributions (Generalized Functions) ◦ Power and energy of signals ◦ Correlation functions of deterministic signals <ul style="list-style-type: none"> ▪ Autocorrelation function ▪ Crosscorrelation function ▪ Orthogonal signals ▪ Applications of correlation • Linear time-invariant (LTI) systems

	<ul style="list-style-type: none"> ◦ Linearity ◦ Time-invariance ◦ Description of LTI systems by impulse response and frequency response ◦ Convolution ◦ Convolution and correlation ◦ Properties of LTI-systems ◦ Causal systems ◦ Stable systems ◦ Memoryless systems • Fourier Series and Fourier Transform <ul style="list-style-type: none"> ◦ Fourier transform of continuous-time signals, discrete-time signals, periodic signals, non-periodic signals ◦ Properties of the Fourier transform ◦ Fourier transform of some basic signals ◦ Parseval's theorem • Analysis of LTI-systems and signals in the frequency domain <ul style="list-style-type: none"> ◦ Frequency response, magnitude response and phase response ◦ Transmission factor, attenuation, gain ◦ Frequency-flat and frequency-selective LTI-systems ◦ Bandwidth definitions ◦ Basic types of systems (filters), lowpass, highpass, bandpass, bandstop systems ◦ Phase delay and group delay ◦ Linear-phase systems ◦ Distortion-free systems ◦ Spectrum analysis with limited observation window: Leakage effect • Laplace Transform <ul style="list-style-type: none"> ◦ Relation of Fourier transform and Laplace transform ◦ Properties of the Laplace transform ◦ Laplace transform of some basic signals • Analysis of LTI-systems in the s-domain <ul style="list-style-type: none"> ◦ Transfer function of LTI-systems ◦ Relation of Laplace transform, magnitude response and phase response ◦ Analysis of LTI-systems using pole-zero plots ◦ Allpass filters ◦ Minimum-phase, maximum-phase and mixed phase filters ◦ Stable systems • Sampling <ul style="list-style-type: none"> ◦ Sampling theorem ◦ Reconstruction of continuous-time signals in frequency domain and time domain ◦ Oversampling ◦ Aliasing ◦ Sampling with pulses of finite duration, sample and hold ◦ Decimation and interpolation • Discrete-Time Fourier Transform (DTFT) <ul style="list-style-type: none"> ◦ Relation of Fourier transform and DTFT ◦ Properties of the DTFT • Discrete Fourier Transform (DFT) <ul style="list-style-type: none"> ◦ Relation of DTFT and DFT ◦ Cyclic properties of the DFT ◦ DFT matrix ◦ Zero padding ◦ Cyclic convolution ◦ Fast Fourier Transform (FFT) ◦ Application of the DFT: Orthogonal Frequency Division Multiplex (OFDM) • Z-Transform <ul style="list-style-type: none"> ◦ Relation of Laplace transform, DTFT, and z-transform ◦ Properties of the z-transform ◦ Z-transform of some basic discrete-time signals • Discrete-time systems, digital filters <ul style="list-style-type: none"> ◦ FIR and IIR filters ◦ Z-transform of digital filters ◦ Analysis of discrete-time systems using pole-zero plots in the z-domain ◦ Stability ◦ Allpass filters ◦ Minimum-phase, maximum-phase and mixed-phase filters ◦ Linear phase filters
<p>Literature</p>	<ul style="list-style-type: none"> • T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 • K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. • B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997 • J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 • S. Haykin, B. van Veen: Signals and systems. Wiley. • Oppenheim, A.S. Willsky: Signals and Systems. Pearson.

- Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course L0433: Signals and Systems	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0854: Mathematics IV			
Courses			
Title	Typ	Hrs/wk	CP
Differential Equations 2 (Partial Differential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)	Lecture	2	1
Complex Functions (L1041)	Recitation Section (small)	1	1
Complex Functions (L1042)	Recitation Section (large)	1	1
Module Responsible	Prof. Marko Lindner		
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I - III		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<ul style="list-style-type: none"> • Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them. <ul style="list-style-type: none"> • Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. <ul style="list-style-type: none"> • Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. <ul style="list-style-type: none"> • Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 		
<i>Knowledge</i>			
<i>Skills</i>			
Personal Competence			
<i>Social Competence</i>			
<i>Autonomy</i>			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equations 2)		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory		

Course L1043: Differential Equations 2 (Partial Differential Equations)	
Typ	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	<p>Main features of the theory and numerical treatment of partial differential equations</p> <ul style="list-style-type: none"> • Examples of partial differential equations • First order quasilinear differential equations • Normal forms of second order differential equations • Harmonic functions and maximum principle • Maximum principle for the heat equation • Wave equation • Liouville's formula • Special functions • Difference methods • Finite elements
Literature	<ul style="list-style-type: none"> • http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1044: Differential Equations 2 (Partial Differential Equations)	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1045: Differential Equations 2 (Partial Differential Equations)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1038: Complex Functions	
Typ	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	<p>Main features of complex analysis</p> <ul style="list-style-type: none"> • Functions of one complex variable • Complex differentiation • Conformal mappings • Complex integration • Cauchy's integral theorem • Cauchy's integral formula • Taylor and Laurent series expansion • Singularities and residuals • Integral transformations: Fourier and Laplace transformation
Literature	<ul style="list-style-type: none"> • http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1041: Complex Functions	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1042: Complex Functions	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1753: Practical module 4 (dual study program, Bachelor's degree)			
Courses			
Title	Typ	Hrs/wk	CP
Practical term 4 (dual study program, Bachelor's degree) (L2882)			
Module Responsible	Dr. Henning Haschke		
Admission Requirements	None		
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Successful completion of practical module 3 as part of the dual Bachelor's course • course B from the module on interlinking theory and practice as part of the dual Bachelor's course 		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<p><i>Knowledge</i> Dual students ...</p> <ul style="list-style-type: none"> • ... understand the company's strategic orientation, as well as the functions and organisation of central departments with their decision-making structures, network relationships, and relevant company communication. • ... have developed an understanding of the requirements and responsibilities of the engineering profession, know the scope and limits of the professional field of activity. • ... can combine their knowledge of facts, principles, theories and methods gained from previous study content with acquired practical knowledge - in particular their knowledge of practical professional procedures and approaches, in the current field of activity. <p><i>Skills</i> Dual students ...</p> <ul style="list-style-type: none"> • ... apply technical theoretical knowledge to current problems in their own field of work, and evaluate work processes and results, taking into account different possible courses of action. • ... use technology, equipment and resources in accordance with the assigned work areas and tasks, and can assess operational processes and procedures with regard to the intended work results/objectives. • ... implement the university's application recommendations in relation to their current tasks. <p>Personal Competence</p> <p><i>Social Competence</i> Dual students ...</p> <ul style="list-style-type: none"> • ... are able to plan work processes cooperatively, across work areas and in heterogeneous groups. • ... communicate professionally with operational stakeholders and present complex issues in a structured, targeted and convincing manner. <p><i>Autonomy</i> Dual students ...</p> <ul style="list-style-type: none"> • ... assume responsibility for work assignments and areas, and coordinate the associated work processes. • ... document and reflect on the relevance of subject modules and specialisations for work as an engineer, as well as the implementation of the university's application recommendations and the associated challenges of a positive transfer of knowledge between theory and practice. 		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and scale	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L2882: Practical term 4 (dual study program, Bachelor's degree)	
Typ	
Hrs/wk	0
CP	6
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Lecturer	Dr. Henning Haschke
Language	DE
Cycle	SoSe
Content	<p>Company onboarding process</p> <ul style="list-style-type: none"> • Assigning work area(s) • Extending responsibilities and authorisations of the dual student within the company • Independent work tasks and areas • Participating in project teams • Scheduling the relevant practical module • Theory/practice transfer options • Scheduling the examination phase/subsequent study semester <p>Operational knowledge and skills</p> <ul style="list-style-type: none"> • Company-specific: strategic direction, organisation of central business and work areas, departments, decision-making structures, network relationships and internal communication • Linking facts, principles and theories with practical knowledge • Process and procedure options within the labour-market-relevant field of engineering • Operational technology, equipment and resources • Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company <p>Sharing/reflecting on learning</p> <ul style="list-style-type: none"> • E-portfolio • Relevance of subject modules and specialisations when working as an engineer • University application recommendations for transferring knowledge between theory and practice
Literature	<ul style="list-style-type: none"> • Studierendenhandbuch • Betriebliche Dokumente • Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer

Module M1805: Computational Mechanics				
Courses				
Title		Typ	Hrs/wk	CP
Computational Mechanics (Exercises) (L1138)		Recitation Section (small)	2	2
Computational Multibody Dynamics (L1137)		Integrated Lecture	2	2
Computational Structural Mechanics (L2475)		Integrated Lecture	2	2
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I-III and Engineering Mechanics I-III			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
<i>Knowledge</i>	The students can <ul style="list-style-type: none"> describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. 			
<i>Skills</i>	The students can <ul style="list-style-type: none"> explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods from numerical mechanics to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 			
Personal Competence				
<i>Social Competence</i>	The students can work in groups and support each other to overcome difficulties.			
<i>Autonomy</i>	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	No	15 %	Midterm	Midterm Mehrkörpersysteme
	No	5 %	Excercises	Hausaufgaben
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory			

Course L1138: Computational Mechanics (Exercises)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried, Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course L1137: Computational Multibody Dynamics	
Typ	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Modelling of mechanical systems • Linear versus nonlinear vibration • Numerical methods for time integration • Vibrations with multiple degrees of freedom: free, damped, forced, modal transformation • Concepts from analytical mechanics • Spatial multibody systems • Linearization of multibody systems • Introduction to Matlab
Literature	<p>K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).</p>

Course L2475: Computational Structural Mechanics	
Typ	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	<p>The lecture Computational Structural Mechanics extends the content of the lecture Engineering Mechanic II. It bridges the gap between the manual calculation of mechanical stress and deformation in systems with a particularly simple geometry and the efficient computer-based computation of general mechanical systems:</p> <ul style="list-style-type: none"> • Basics of linear continuum mechanics • Planar structures: plate, membrane, slab • Linientragwerke: beam, cable, truss • Weak form and Galerkin's method • Finite element method: theory and application • Principles of mechanics: principle of virtual work, virtual displacements, virtual forces
Literature	Gross, Hauger, Wriggers, "Technische Mechanik 4", Springer

Module M0671: Technical Thermodynamics I			
Courses			
Title	Typ	Hrs/wk	CP
Technical Thermodynamics I (L0437)	Lecture	2	4
Technical Thermodynamics I (L0439)	Recitation Section (large)	1	1
Technical Thermodynamics I (L0441)	Recitation Section (small)	1	1
Module Responsible	Prof. Arne Speerforck		
Admission Requirements	None		
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Mechanics		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 st law of Thermodynamics and are aware about the limits of energy conversions according to 2 nd law of Thermodynamics. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy, entropy and also the meaning of exergy and energy. They are able to draw the Carnot cycle in a Thermodynamics related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamics.		
<i>Skills</i>	Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables.		
Personal Competence			
<i>Social Competence</i>	The students can discuss in small groups and work out a solution. You can answer comprehension questions about the content that are provided in the lecture with the ClickerOnline tool "TurningPoint" after discussions with other students.		
<i>Autonomy</i>	Students can understand the problems posed in tasks physically. They are able to select the methods taught in the lecture and exercise to solve problems and apply them independently to different types of tasks.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Core Qualification: Elective Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory		

Course L0437: Technical Thermodynamics I	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	<ol style="list-style-type: none"> 1. Introduction 2. Fundamental terms 3. Thermal Equilibrium and temperature <ol style="list-style-type: none"> 3.1 Thermal equation of state 4. First law <ol style="list-style-type: none"> 4.1 Heat and work 4.2 First law for closed systems 4.3 First law for open systems 4.4 Examples 5. Equations of state and changes of state <ol style="list-style-type: none"> 5.1 Changes of state 5.2 Cycle processes 6. Second law <ol style="list-style-type: none"> 6.1 Carnot process 6.2 Entropy 6.3 Examples 6.4 Exergy 7. Thermodynamic properties of pure fluids <ol style="list-style-type: none"> 7.1 Fundamental equations of Thermodynamics 7.2 Thermodynamic potentials 7.3 Calorific state variables for arbitrary fluids 7.4 state equations (van der Waals u.a.)
Literature	<ul style="list-style-type: none"> • Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 • Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 • Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course L0439: Technical Thermodynamics I	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0441: Technical Thermodynamics I	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0725: Production Engineering			
Courses			
Title	Typ	Hrs/wk	CP
Production Engineering I (L0608)	Lecture	2	2
Production Engineering I (L0612)	Recitation Section (large)	1	1
Production Engineering II (L0610)	Lecture	2	2
Production Engineering II (L0611)	Recitation Section (large)	1	1
Module Responsible	Prof. Jan Hendrik Dege		
Admission Requirements	None		
Recommended Previous Knowledge	no course assessments required internship recommended		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Students are able to ... <ul style="list-style-type: none"> name basic criteria for the selection of manufacturing processes. name the main groups of Manufacturing Technology. name the application areas of different manufacturing processes. name boundaries, advantages and disadvantages of the different manufacturing process. describe elements, geometric properties and kinematic variables and requirements for tools, workpiece and process. explain the essential models of manufacturing technology. 		
<i>Skills</i>	Students are able to... <ul style="list-style-type: none"> select manufacturing processes in accordance with the requirements. design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced. assess components in terms of their production-oriented construction. 		
Personal Competence			
<i>Social Competence</i>	Students are able to ... <ul style="list-style-type: none"> develop solutions in a production environment with qualified personnel at technical level and represent decisions. 		
<i>Autonomy</i>	Students are able to .. <ul style="list-style-type: none"> interpret independently the manufacturing process. assess own strengths and weaknesses in general. assess their learning progress and define gaps to be improved. assess possible consequences of their actions. 		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Elective Compulsory Mechatronics: Specialisation Medical Engineering: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory		

Course L0608: Production Engineering I	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jan Hendrik Dege
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Manufacturing Accuracy • Manufacturing Metrology • Measurement Errors and Uncertainties • Introduction to Forming • Massiv forming and Sheet Metal Forming • Introduction to Machining Technology • Geometrically defined machining (Turning, milling, drilling, broaching, planning)
Literature	<p>Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter.; Ziegmann, Gerhard,;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007</p> <p>Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004</p> <p>Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008</p> <p>Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008</p> <p>Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)</p> <p>Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006</p> <p>Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996</p> <p>Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)</p>

Course L0612: Production Engineering I	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jan Hendrik Dege
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0610: Production Engineering II	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jan Hendrik Dege, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Geometrically undefined machining (grinding, lapping, honing) • Introduction into erosion technology • Introduction into blastig processes • Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) • Fundamentals of Laser Technology • Process versions and Fundamentals of Laser Joining Technology
Literature	<p>Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005)</p> <p>Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007)</p> <p>Spur, Günter (Stöferle, Theodor,;): Urformen. München [u.a.] : Hanser, 1981</p> <p>Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007</p>

Course L0611: Production Engineering II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jan Hendrik Dege, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0833: Introduction to Control Systems			
Courses			
Title		Typ	Hrs/wk
Introduction to Control Systems (L0654)		Lecture	2
Introduction to Control Systems (L0655)		Recitation Section (small)	2
Module Responsible	Prof. Timm Faulwasser		
Admission Requirements	None		
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	<ul style="list-style-type: none"> • Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems • They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus • They can explain the Nyquist stability criterion and the stability margins derived from it. • They can explain the role of the phase margin in analysis and synthesis of control loops • They can explain the way a PID controller affects a control loop in terms of its frequency response • They can explain issues arising when controllers designed in continuous time domain are implemented digitally 		
<i>Skills</i>	<ul style="list-style-type: none"> • Students can transform models of linear dynamic systems from time to frequency domain and vice versa • They can simulate and assess the behavior of systems and control loops • They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules • They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques • They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation • They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks 		
Personal Competence			
<i>Social Competence</i>	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs		
<i>Autonomy</i>	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems.		
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the Following Curricula	<p>General Engineering Science (German program, 7 semester): Core Qualification: Compulsory</p> <p>Bioprocess Engineering: Core Qualification: Compulsory</p> <p>Chemical and Bioprocess Engineering: Core Qualification: Compulsory</p> <p>Data Science: Specialisation II. Application: Elective Compulsory</p> <p>Electrical Engineering: Core Qualification: Compulsory</p> <p>Electrical Engineering and Information Technology: Core Qualification: Compulsory</p> <p>Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory</p> <p>Computer Science in Engineering: Core Qualification: Compulsory</p> <p>Logistics and Mobility: Specialisation Information Technology: Elective Compulsory</p> <p>Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory</p> <p>Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory</p> <p>Mechanical Engineering: Core Qualification: Compulsory</p> <p>Mechatronics: Core Qualification: Compulsory</p> <p>Technomathematics: Specialisation III. Engineering Science: Elective Compulsory</p> <p>Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory</p> <p>Process Engineering: Core Qualification: Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Information Technology: Elective Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Traffic Planning and Systems: Elective Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Production Management and Processes: Elective Compulsory</p>		

Course L0654: Introduction to Control Systems	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Timm Faulwasser
Language	DE
Cycle	WiSe
Content	<p>Signals and systems</p> <ul style="list-style-type: none"> • Linear systems, differential equations and transfer functions • First and second order systems, poles and zeros, impulse and step response • Stability <p>Feedback systems</p> <ul style="list-style-type: none"> • Principle of feedback, open-loop versus closed-loop control • Reference tracking and disturbance rejection • Types of feedback, PID control • System type and steady-state error, error constants • Internal model principle <p>Root locus techniques</p> <ul style="list-style-type: none"> • Root locus plots • Root locus design of PID controllers <p>Frequency response techniques</p> <ul style="list-style-type: none"> • Bode diagram • Minimum and non-minimum phase systems • Nyquist plot, Nyquist stability criterion, phase and gain margin • Loop shaping, lead lag compensation • Frequency response interpretation of PID control <p>Time delay systems</p> <ul style="list-style-type: none"> • Root locus and frequency response of time delay systems • Smith predictor <p>Digital control</p> <ul style="list-style-type: none"> • Sampled-data systems, difference equations • Tustin approximation, digital implementation of PID controllers <p>Software tools</p> <ul style="list-style-type: none"> • Introduction to Matlab, Simulink, Control toolbox • Computer-based exercises throughout the course
Literature	<ul style="list-style-type: none"> • Werner, H., Lecture Notes „Introduction to Control Systems“ • G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 • K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 • R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Timm Faulwasser
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1754: Practical module 5 (dual study program, Bachelor's degree)			
Courses			
Title	Typ	Hrs/wk	CP
Practical term 5 (dual study program, Bachelor's degree) (L2883)		0	6
Module Responsible	Dr. Henning Haschke		
Admission Requirements	None		
Recommended Previous Knowledge	<ul style="list-style-type: none"> • Successful completion of practical module 4 as part of the dual Bachelor's course • course C from the module on interlinking theory and practice as part of the dual Bachelor's course 		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Dual students ... <ul style="list-style-type: none"> • ... combine their knowledge of facts, principles, theories and methods gained from previous study content with acquired practical knowledge - in particular their knowledge of practical professional procedures and approaches, in the current field of activity. • ... have a critical understanding of the practical applications of their engineering subject. 		
<i>Skills</i>	Dual students ... <ul style="list-style-type: none"> • ... apply technical theoretical knowledge to complex, interdisciplinary problems within the company, and evaluate the associated work processes and results, taking into account different possible courses of action. • ... implement the university's application recommendations with regard to their current tasks. • ... develop new solutions as well as procedures and approaches in their field of activity and area of responsibility - including in the case of frequently changing requirements (systemic skills). • ... are able to analyse and evaluate operational issues using academic methods. 		
Personal Competence			
<i>Social Competence</i>	Dual students ... <ul style="list-style-type: none"> • ... work responsibly in operational project teams and proactively deal with problems within their team. • ... represent complex engineering viewpoints, facts, problems and solution approaches in discussions with internal and external stakeholders and develop these further together. 		
<i>Autonomy</i>	Dual students ... <ul style="list-style-type: none"> • ... define goals for their own learning and working processes as engineers. • ... document and reflect on learning and work processes in their area of responsibility. • ... document and reflect on the relevance of subject modules, specialisations and research for work as an engineer, as well as the implementation of the university's application recommendations and the associated challenges of a positive transfer of knowledge between theory and practice. 		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and scale	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Electrical Engineering and Information Technology: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory		

Course L2883: Practical term 5 (dual study program, Bachelor's degree)	
Typ	
Hrs/wk	0
CP	6
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Lecturer	Dr. Henning Haschke
Language	DE
Cycle	WiSe
Content	<p>Company onboarding process</p> <ul style="list-style-type: none"> • Assigning a future professional field of activity as an engineer (B.Sc.) and associated areas of work • Extending responsibilities and authorisations of the dual student within the company up to the intended first assignment after completing their studies or to the assignment completed during the subsequent dual Master's course • Taking personal responsibility within a team - in their own area of responsibility and across departments • Scheduling the final practical module with a clear correlation to work structures • Internal agreement on a potential topic for the Bachelor's dissertation • Planning the Bachelor's dissertation within the company in cooperation with TU Hamburg • Scheduling the examination phase/sixth study semester <p>Operational knowledge and skills</p> <ul style="list-style-type: none"> • Company-specific: dealing with change, team development, responsibility as an engineer in their own future field of work (B.Sc.), dealing with complex contexts and unresolved problems, developing and implementing innovative solutions • Specialising in one field of work (final dissertation) • Systemic skills • Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company <p>Sharing/reflecting on learning</p> <ul style="list-style-type: none"> • E-portfolio • Relevance of subject modules and specialisations when working as an engineer • Importance of research and innovation when working as an engineer • University application recommendations for transferring knowledge between theory and practice
Literature	<ul style="list-style-type: none"> • Studierendenhandbuch • Betriebliche Dokumente • Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer

Module M0829: Foundations of Management			
Courses			
Title		Typ	Hrs/wk CP
Management Tutorial (L0882)		Recitation Section (small)	2 3
Introduction to Management (L0880)		Lecture	3 3
Module Responsible	Prof. Christian L�uthje		
Admission Requirements	None		
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<p><i>Knowledge</i></p> <p>After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</p> <ul style="list-style-type: none"> • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management • explain the most important aspects of and goals in Management and name the most important aspects of entrepreneurial projects • describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human resource management, information management, innovation management and marketing • explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance • state basics from accounting and costing and selected controlling methods. <p><i>Skills</i></p> <p>Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</p> <ul style="list-style-type: none"> • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems <p>Personal Competence</p> <p><i>Social Competence</i></p> <p>Students are able to</p> <ul style="list-style-type: none"> • work successfully in a team of students • to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project • to communicate appropriately and • to cooperate respectfully with their fellow students. <p><i>Autonomy</i></p> <p>Students are able to</p> <ul style="list-style-type: none"> • work in a team and to organize the team themselves • to write a report on their project. 		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Subject theoretical and practical work		
Examination duration and scale	several written exams during the semester plus final test (90 minutes)		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Specialisation Bio Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Engineering: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Electrical Engineering and Information Technology: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Biotechnologies: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Systems / Renewable Energies: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Water Technologies: Elective Compulsory Computer Science in Engineering: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory		

<p>Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Electrical Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory</p>

Course L0882: Management Tutorial	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	WiSe/SoSe
Content	<p>In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.</p> <p>If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor.</p>
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction to Management	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Matthias Meyer, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Christian Thies, Prof. Christoph Ihl, Prof. Kathrin Fischer, Prof. Moritz Göldner, Prof. Thomas Wrona, Prof. Thorsten Blecker, Prof. Tim Schweisfurth, Prof. Wolfgang Kersten
Language	DE
Cycle	WiSe/SoSe
Content	<ul style="list-style-type: none"> • Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management • Important definitions from Management, • Developing Objectives for Business, and their relation to important Business functions • Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales • Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management • Definitions as information, information systems, aspects of data security and strategic information systems • Definition and Relevance of innovations, e.g. innovation opportunities, risks etc. • Relevance of marketing, B2B vs. B2C-Marketing • different techniques from the field of marketing (e.g. scenario technique), pricing strategies • important organizational structures • basics of human ressource management • Introduction to Business Planning and the steps of a planning process • Decision Analysis: Elements of decision problems and methods for solving decision problems • Selected Planning Tasks, e.g. Investment and Financial Decisions • Introduction to Accounting: Accounting, Balance-Sheets, Costing • Relevance of Controlling and selected Controlling methods • Important aspects of Entrepreneurship projects
Literature	<p>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</p> <p>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</p> <p>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</p> <p>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</p> <p>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.</p> <p>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</p> <p>Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</p> <p>Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.</p>

Module M0956: Measurement Technology for Mechanical Engineers				
Courses				
Title		Typ	Hrs/wk	CP
Practical Course: Measurement and Control Systems (L1119)		Practical Course	2	2
Measurement Technology for Mechanical Engineering (L1116)		Lecture	2	2
Measurement Technology for Mechanical Engineering (L1118)		Practical Course	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
<i>Knowledge</i>	Students are able to name the most important fundamentals of the Measurement Technology (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for different kinds of quantities to be measured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).			
	They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)			
<i>Skills</i>	Students can select suitable measuring methods to given problems and can use referring measurement devices in practice.			
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.			
Personal Competence				
<i>Social Competence</i>	Students can arrive at work results in groups and document them in a common report.			
<i>Autonomy</i>	Students are able to familiarize themselves with new measurement technologies.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	Compulsory	Bonus	Form	Description
	Yes	None	Subject	theoretical and practical work
Examination	Subject theoretical and practical work			
Examination duration and scale	Successful execution of up to 12 short experiments on measurements technology and successful participation in the practical course of "Practical Course: Measurement and Control Systems"			
Assignment for the following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Elective Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Engineering Science: Specialisation Mechanical Engineering and Management: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Specialisation Electrical Systems: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation II. Production Management and Processes: Elective Compulsory			

Course L1119: Practical Course: Measurement and Control Systems	
Typ	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	<p>The content of experiment 1:</p> <p>Accuracy testing of a delta robot: In the course of the experiment, the accuracy of a delta robot is tested through 3 tasks. The first task focuses on the online/offline programming of the robot. The second task deals with sensor calibration. In the third task, the radius of a sphere is determined using three different measurement methods (manual measurement, manual measurement with a sensor, automatic data acquisition and data processing).</p> <p>The content of experiment 3:</p> <p>The aim of the task is to enable the parallel kinematics to find objects, grasp them and place them on a static target position. For this purpose, the end effector of the kinematics is equipped with an optical sensor (camera), whose characteristics are to be defined. The measuring range of the sensor is to be identified and, based on this, a movement strategy for finding the objects is to be developed and implemented. Once the objects have been found, they are to be picked up with a magnetic gripper and transported to their destination.</p> <p>The content of experiment 4:</p> <p>The aim of the task is to enable the parallel kinematics to find objects, grab them and deposit them on a moving platform. For this purpose, the end effector of the kinematics is equipped with an optical sensor (camera), the properties of which were worked out in experiment 3. Based on this, the parallel kinematics should now be able to follow the moving platform. For this purpose, a position control must be developed and implemented. Once the controller has been appropriately configured, the objects can be placed on the moving platform.</p>
Literature	<p>Versuch 1:</p> <ul style="list-style-type: none"> • 1)Weck, Manfred; Brecher, Christian. Maschinenarten und Anwendungsbereiche. Springer (Werkzeugmaschinen, 1, Ed. 6). 2005 • 2)Weck, Manfred; Brecher, Christian. Automatisierung von Maschinen und Anlagen. Springer (Werkzeugmaschinen, 4, Ed. 6). 2006 • 3)Siciliano, Bruno; Khatib, Oussama. Springer handbook of robotics. Springer. 2008 • 4)Schüppstuhl, Thorsten. VL Grundlagen der Handhabungs- und Montagetechnik. 2017 <p>Versuch 3:</p> <ul style="list-style-type: none"> • 1)Hompel, Michael, Hubert Büchter, and Ulrich Franzke. Identifikationssysteme und Automatisierung. Springer-Verlag, 2007. • ArUco Library Documentation, https://docs.google.com/document/d/1QU9KoBtjSM2kF6iTOjQ76xqL7H0TEtXrjX5kwi9Kgc/edit Stand 10/21 • Demant, Christian, Bernd Streicher-Abel, and Axel Springhoff. Industrielle Bildverarbeitung: wie optische Qualitätskontrolle wirklich funktioniert. Springer-Verlag, 2011. <p>Versuch 4:</p> <ul style="list-style-type: none"> • 1)Will, Thorsten T. C++ Das umfassende Handbuch, Rheinwerk Computing, 2020 • 2)Hildebrand, Walter. Grundkurs Regelungstechnik : Grundlagen für Bachelorstudiengänge aller technischen Fachrichtungen und Wirtschaftsingenieure, Springer Vieweg, 2013. • 3)Erlenkötter, Helmut. C++: Objektorientiertes Programmieren von Anfang an, rororo, 2016 <p>Bibliography:</p> <p>Experiment 1</p> <ul style="list-style-type: none"> • 1)Weck, Manfred; Brecher, Christian. Maschinenarten und Anwendungsbereiche. Springer (Werkzeugmaschinen, 1, Ed. 6). 2005 • 2)Weck, Manfred; Brecher, Christian. Automatisierung von Maschinen und Anlagen. Springer (Werkzeugmaschinen, 4, Ed. 6). 2006 • 3)Siciliano, Bruno; Khatib, Oussama. Springer handbook of robotics. Springer. 2008 • 4)Schüppstuhl, Thorsten. VL Grundlagen der Handhabungs- und Montagetechnik. 2017 <p>Experiment 3:</p> <ul style="list-style-type: none"> • 1)Hompel, Michael, Hubert Büchter, and Ulrich Franzke. Identifikationssysteme und Automatisierung. Springer-Verlag, 2007. • ArUco Library Documentation, https://docs.google.com/document/d/1QU9KoBtjSM2kF6iTOjQ76xqL7H0TEtXrjX5kwi9Kgc/edit Stand 10/21 • Demant, Christian, Bernd Streicher-Abel, and Axel Springhoff. Industrielle Bildverarbeitung: wie optische Qualitätskontrolle wirklich funktioniert. Springer-Verlag, 2011. <p>Experiment 4:</p> <ul style="list-style-type: none"> • 1)Will, Thorsten T. C++ Das umfassende Handbuch, Rheinwerk Computing, 2020 • 2)Hildebrand, Walter. Grundkurs Regelungstechnik : Grundlagen für Bachelorstudiengänge aller technischen Fachrichtungen und Wirtschaftsingenieure, Springer Vieweg, 2013. • 3)Erlenkötter, Helmut. C++: Objektorientiertes Programmieren von Anfang an, rororo, 2016

Course L1116: Measurement Technology for Mechanical Engineering	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	EN
Cycle	WiSe
Content	<p>1 Fundamentals</p> <p>1.1 Quantities and Units</p> <p>1.2 Uncertainty</p> <p>1.3 Calibration</p> <p>1.4 Static and Dynamic Properties of Sensors and Systems</p> <p>2 Measurement of Electrical Quantities</p> <p>2.1 Current and Voltage</p> <p>2.2 Impedance</p> <p>2.3 Amplification</p> <p>2.4 Oscilloscope</p> <p>2.5 Analog-to-Digital Conversion</p> <p>2.6 Data Transmission</p> <p>3 Measurement of Nonelectric Quantities</p> <p>3.1 Temperature</p> <p>3.2 Length, Displacement, Angle</p> <p>3.3 Strain, Force, Pressure</p> <p>3.4 Flow</p> <p>3.5 Time, Frequency</p>
Literature	<p>Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3.</p> <p>Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.</p>

Course L1118: Measurement Technology for Mechanical Engineering	
Typ	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	EN
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0688: Technical Thermodynamics II			
Courses			
Title	Typ	Hrs/wk	CP
Technical Thermodynamics II (L0449)	Lecture	2	4
Technical Thermodynamics II (L0450)	Recitation Section (large)	1	1
Technical Thermodynamics II (L0451)	Recitation Section (small)	1	1
Module Responsible	Prof. Arne Speerforck		
Admission Requirements	None		
Recommended Previous Knowledge	Elementary knowledge in Mathematics, Mechanics and Technical Thermodynamics I		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between anti clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamics related diagrams. They know the laws of gas mixtures, especially of humid air processes and are able to perform simple combustion calculations. They are provided with basic knowledge in gas dynamics and know the definition of the speed of sound and know about a Laval nozzle.		
<i>Skills</i>	Students are able to use thermodynamic laws for the design of technical processes. Especially they are able to formulate energy, exergy- and entropy balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from a tank. They are able to transform a verbal formulated message into an abstract formal procedure.		
Personal Competence			
<i>Social Competence</i>	The students are able to discuss in small groups and develop an approach. You can answer comprehension questions about the content that are provided in the lecture with the ClickerOnline tool "TurningPoint" after discussions with other students.		
<i>Autonomy</i>	Students can physically understand and explain the complex problems (cycle processes, air conditioning processes, combustion processes) set in tasks. They are able to select the methods taught in the lecture and exercise to solve complex problems and apply them independently to different types of tasks.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core Qualification: Compulsory		

Course L0449: Technical Thermodynamics II	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	WiSe
Content	8. Cycle processes 7. Gas - vapor - mixtures 10. Open systems with constant flow rates 11. Combustion processes 12. Special fields of Thermodynamics
Literature	<ul style="list-style-type: none"> • Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 • Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 • Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course L0450: Technical Thermodynamics II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0451: Technical Thermodynamics II	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1320: Simulation and Design of Mechatronic Systems			
Courses			
Title		Typ	Hrs/wk
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2
Simulation and Design of Mechatronic Systems (L1823)		Recitation Section (large)	1
Simulation and Design of Mechatronic Systems (L1824)		Practical Course	1
Module Responsible	Prof. Robert Seifried		
Admission Requirements	None		
Recommended Previous Knowledge	Fundamentals of mechanics, control theory and electrical engineering		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Students are able to describe methods and calculations for design, modeling, simulation and optimization of mechatronic systems.		
<i>Skills</i>	Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulate and design simple systems and implement those in laboratory conditions.		
Personal Competence			
<i>Social Competence</i>	Students are able to work goal-oriented in small mixed groups and present results to target groups.		
<i>Autonomy</i>	Students are able to recognize and improve knowledge deficits independently.		
	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	60 min		
Assignment for the Following Curricula	Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory Mechatronics: Core Qualification: Compulsory		

Course L1822: Simulation and Design of Mechatronic Systems	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried, Dr.-Ing. Daniel-André Dücker
Language	DE
Cycle	WiSe
Content	Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab® and Simulink®
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung

Course L1823: Simulation and Design of Mechatronic Systems	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1824: Simulation and Design of Mechatronic Systems	
Typ	Practical Course
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0610: Electrical Machines and Actuators			
Courses			
Title	Typ	Hrs/wk	CP
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern		
Admission Requirements	None		
Recommended Previous Knowledge	Basics of mathematics, in particular complex numbers, integrals, differentials Basics of electrical engineering and mechanical engineering		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	<p><i>Knowledge</i></p> <p>Students can draw and explain the basic principles of electric and magnetic fields.</p> <p>They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.</p> <p><i>Skills</i></p> <p>Students are able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. For this they apply the usual methods of the design of electric machines.</p> <p>They can calculate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.</p> <p>Personal Competence</p> <p><i>Social Competence</i> none</p> <p><i>Autonomy</i> Students are able independently to calculate electric and magnetic fields for applications. They are able to analyse independently the operational performance of electric machines from the characteristic data and they can calculate thereof selected quantities and characteristic curves.</p>		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Subject theoretical and practical work		
Examination duration and scale	Design of four machines and actuators, review of design files		
Assignment for the Following Curricula	<p>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</p> <p>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory</p> <p>General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory</p> <p>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory</p> <p>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory</p> <p>Electrical Engineering: Core Qualification: Elective Compulsory</p> <p>Electrical Engineering and Information Technology: Core Qualification: Elective Compulsory</p> <p>Engineering Science: Specialisation Electrical Engineering: Elective Compulsory</p> <p>Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory</p> <p>Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory</p> <p>Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory</p> <p>Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory</p> <p>Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory</p> <p>Mechanical Engineering: Core Qualification: Elective Compulsory</p> <p>Mechatronics: Specialisation Naval Engineering: Compulsory</p> <p>Mechatronics: Core Qualification: Compulsory</p> <p>Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory</p> <p>Mechatronics: Specialisation Electrical Systems: Elective Compulsory</p> <p>Technomathematics: Specialisation III. Engineering Science: Elective Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Information Technology: Elective Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Traffic Planning and Systems: Elective Compulsory</p> <p>Engineering and Management - Major in Logistics and Mobility: Specialisation II. Production Management and Processes: Elective Compulsory</p>		

Course L0293: Electrical Machines and Actuators	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	<p>Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators</p> <p>Magnetic field: force, flux line, Ampere's law, field at boundaries, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators</p> <p>Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-circuit characteristics, vector diagrams, motor and generator operation, stepper motors</p> <p>DC-Machines: Construction and layout, torque generation mechanisms, torque vs speed characteristics, commutation,</p> <p>Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands' diagram), torque vs. speed characteristics, rotor layout (squirrel-cage vs. sliprings),</p> <p>Drives with variable speed, inverter fed operation, special drives</p>
Literature	<p>Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313</p> <p>Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122</p> <p>"Grundlagen der Elektrotechnik" - anderer Autoren</p> <p>Fachbücher "Elektrische Maschinen"</p>

Course L0294: Electrical Machines and Actuators	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0777: Semiconductor Circuit Design			
Courses			
Title	Typ	Hrs/wk	CP
Semiconductor Circuit Design (L0763)	Lecture	3	4
Semiconductor Circuit Design (L0864)	Recitation Section (small)	1	2
Module Responsible	NN		
Admission Requirements	None		
Recommended Previous Knowledge	Fundamentals of electrical engineering Basics of physics, especially semiconductor physics		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence <i>Knowledge</i>	<ul style="list-style-type: none"> Students are able to explain the functionality of different MOS devices in electronic circuits. Students are able to explain how analog circuits functions and where they are applied. Students are able to explain the functionality of fundamental operational amplifiers and their specifications. Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages. Students have knowledge about memory circuits and can explain their functionality and specifications. Students know the appropriate fields for the use of bipolar transistors. 		
<i>Skills</i>	<ul style="list-style-type: none"> Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits. Students are able to develop different logic circuits and can design different types of logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. 		
Personal Competence <i>Social Competence</i>	<ul style="list-style-type: none"> Students are able work efficiently in heterogeneous teams. Students working together in small groups can solve problems and answer professional questions. 		
<i>Autonomy</i>	<ul style="list-style-type: none"> Students are able to assess their level of knowledge. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core Qualification: Compulsory Electrical Engineering and Information Technology: Core Qualification: Compulsory Engineering Science: Specialisation Electrical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechatronics: Specialisation Electrical Systems: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L0763: Semiconductor Circuit Design	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Qiang Li, Julian Singer
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Repetition Semiconductorphysics and Diodes • Functionality and characteristic curve of bipolar transistors • Basic circuits with bipolar transistors • Functionality and characteristic curve of MOS transistors • Basic circuits with MOS transistors for amplifiers • Operational amplifiers and their applications • Typical applications for analog and digital circuits • Realization of logical functions • Basic circuits with MOS transistors for combinational logic • Memory circuits • Basic circuits with MOS transistors for sequential logic • Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	<p>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</p> <p>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555</p> <p>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</p> <p>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</p> <p>URL: http://dx.doi.org/10.1007/978-3-642-20887-4</p> <p>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</p> <p>URL: http://www.ciando.com/img/bo</p>

Course L0864: Semiconductor Circuit Design	
Typ	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Qiang Li, Julian Singer
Language	DE
Cycle	SoSe
Content	<ul style="list-style-type: none"> • Basic circuits and characteristic curves of bipolar transistors • Basic circuits and characteristic curves of MOS transistors for amplifiers • Realization and dimensioning of operational amplifiers • Realization of logic functions • Basic circuits with MOS transistors for combinational and sequential logic • Memory circuits • Circuits for analog-to-digital and digital-to-analog converters • Design of exemplary circuits
Literature	<p>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</p> <p>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555</p> <p>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</p> <p>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</p> <p>URL: http://dx.doi.org/10.1007/978-3-642-20887-4</p> <p>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</p> <p>URL: http://www.ciando.com/img/bo</p>

Thesis

Module M1800: Bachelor thesis (dual study program)

Courses

Title	Typ	Hrs/wk	CP
Module Responsible	Professoren der TUHH		
Admission Requirements	None		
Recommended Previous Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
<i>Knowledge</i>	Dual students... <ul style="list-style-type: none"> ... choose central theoretical principles from their field of study (facts, theories, methods) in relation to problems and applications, present them and discuss them critically. ... further develop their subject-related and practical knowledge as appropriate and link both areas of knowledge together. ... present the current research available on a chosen topic or on a chosen operational issue linked to their subject. 		
<i>Skills</i>	Dual students... <ul style="list-style-type: none"> ... evaluate both the basic knowledge linked to their field of study acquired at the university and professional knowledge gained through the company, then purposefully use it to solve technical and application-related problems. ... analyse questions and problems using the methods learned throughout their studies (including practical phases), reach factually justifiable decisions and develop application-specific solutions. ... critically analyse the results of their own research work from a subject-specific and professional perspective. 		
Personal Competence			
<i>Social Competence</i>	Dual students... <ul style="list-style-type: none"> ... present a professional problem in the form of an academic question for a specialist audience in a structured, comprehensible and factually correct manner, both orally and in writing. ... respond to questions as part of a specialist discussion and answer them appropriately. In doing so, they argue their own evaluations and points of view convincingly. 		
<i>Autonomy</i>	Dual students... <ul style="list-style-type: none"> ... structure a comprehensive, chronological workflow and work independently on a question to a high academic level within a given period of time. ... identify, develop and link necessary knowledge and material to handle an academic and application-related problem. ... apply the essential techniques of academic work when conducting their own research on an operational issue. 		
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0		
Credit points	12		
Course achievement	None		
Examination	Thesis		
Examination duration and scale	According to General Regulations		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Thesis: Compulsory Civil- and Environmental Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering and Information Technology: Thesis: Compulsory Engineering Science: Thesis: Compulsory Green Technologies: Energy, Water, Climate: Thesis: Compulsory Computer Science in Engineering: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory Engineering and Management - Major in Logistics and Mobility: Thesis: Compulsory		