

### Module Manual

Bachelor of Science

# General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2016

Updated: 28th September 2018

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## **Module Manual**

Bachelor

## General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2016

Updated: 28th September 2018

#### **Program description**

#### Content

The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study (civil engineering, biotechnology, electrical engineering, energy- and environmental engineering, computer science, mechanical



engineering, medical engineering, naval engineering, process engineering), some of them with further specialisations. GES has with 210 credit points a higher workload compared to other Bachelor study courses. Therefore General Engineering Science is designed for 7 semesters.

#### **Career prospects**

The graduates of the Bachelor program General Engineering Science are directly able to enter a career in the field of mechanical engineering, civil engineering, electrical engineering, process engineering or computer science engineering 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 companies in mechanical, civil, process, electrical and computer science engineering as well as engineering firms.

The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studies, of another technical or of an economic oriented Master study. Most of the modules in the 1<sup>st</sup> and the 2<sup>nd</sup> semester of GES are offered in English.

#### Learning target

#### Knowledge

Students can:

- · Name and describe the mathematical and scientific principles and methods of the engineering sciences;
- Ellucidate the principles and methods of the engineering sciences and present an overview of their subject;

• Explain in detail the foundations, methods and areas of application of their specialization, and, as necessary, their particular focus;

• Recite the foundations and methods of the engineering sciences and provide an overview of the relevant social, ethical, ecological and economic marginal conditions of their subject.

#### Skills

Graduates are able to

• Identify and abstract subject-related problems fundamentally and solve them holistically

• Identify, combine and apply in an interdisciplinary manner the methods appropriate for the desired analysis, modeling, simulation and optimization

• Penetrate, analyze and evaluate products and methods from different branches of engineering on a systems technology basis

- Applofdesign methods from different branches of engineering
- Plan and carry out experiments and interpret the results
- Assess the limits of techniques and methods

• Use their knowledge in an interdisciplinary manner and responsible way, taking economic requirements into consideration

• Evaluate problems in a wider societal context and assess the non-technical repercussions of engineering.

#### **Social Competence**

Graduates are able to

- Present the methods and results of their work comprehensively both orally and in writing
- · Communicate with experts and laypersons about the contents and problems of engineering



- · Respond appropriately to inquiries, additions and comments
- Work in groups, define, allocate and integrate subtasks, reach agreement on schedules and to interact socially.

#### Autonomy

Graduates are able to

• Familiarize themselves with the relevant literature and effectively use databases and other digital sources of information as well as present the results of their work comprehensively both orally and in writing

• Assess their existing competences realistically and develop and carry out strategies for compensating any deficits they identify

- · Learn a range of subjects and work independently
- Expand and deepen their understanding through a process of lifelong learning

#### **Program structure**

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

The internship and the interdisciplinary final thesis is scheduled for the seventh semester.



Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require be are not able to cover fully. Self-reliance, self-management, collaboration and professional an personnel management competences. The department implements these training objectives in i <b>teaching architecture</b> , in its <b>teaching and learning arrangements</b> , in <b>teaching areas</b> and by mear of teaching offerings in which students can qualify by opting for <b>specific competences</b> and <b>competence level</b> at the Bachelor's or Master's level. The teaching offerings are pooled in tw different catalogues for nontechnical complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures the courses in the nontechnical academic programms follow the specific profiling of TUHH degre courses.
	The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles
	The subjects that can be studied in parallel throughout the student's entire study program - if need b it can be studied in one to two semesters. In view of the adaptation problems that individua commonly face in their first semesters after making the transition from school to university and in orde to encourage individually planned semesters abroad, there is no obligation to study these subjects one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other acros semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning courses are part of the learning architecture and are deliberately encouraged in specific courses.
	Fields of Teaching
Knowledge	are based on research findings from the academic disciplines cultural studies, social studies, arts historical studies, migration studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor courses will have the opportunity to learn about business management and start-ups in a goa oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focu is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor and Master's fields. These differences are reflected in the practical examples used, in content topic that refer to different professional application contexts, and in the higher scientific and theoretical leve of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions an different group leadership functions of Bachelor's and Master's graduates in their future working life.



	Specialized Competence (Knowledge)
	Students can
	<ul> <li>locate selected specialized areas with the relevant non-technical mother discipline,</li> <li>outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,</li> <li>different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul>
	Professional Competence (Skills)
	In selected sub-areas students can
Skills	<ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> <li>to handle simple questions in aforementioned scientific disciplines in a sucsessful manner,</li> <li>justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.</li> </ul>
Personal Competence	
	Personal Competences (Social Skills)
Social Competence	<ul> <li>Students will be able</li> <li>to learn to collaborate in different manner,</li> <li>to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> <li>to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul>
	Personal Competences (Self-reliance)
	Students are able in selected areas
Autonomy	<ul> <li>to reflect on their own profession and professionalism in the context of real-life fields of application</li> <li>to organize themselves and their own learning processes</li> <li>to reflect and decide questions in front of a broad education background</li> <li>to communicate a nontechnical item in a competent way in writen form or verbaly</li> <li>to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li> </ul>
Workload in Hours	Depends on choice of courses
Credit points	6

#### Courses

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Information regarding lectures and courses can be found in the corresponding module handbook published separately.



Module M0743: E Fields	electrical Engineering I: Direct Current Networks ar	nd Elect	romagnetic
Courses			
	<b>Typ</b> act Current Networks and Electromagnetic Fields (L0675) Lecture act Current Networks and Electromagnetic Fields (L0676) Recitation Section (small)	<b>Hrs/wk</b> 3 2	<b>CP</b> 5 1
	Prof. Manfred Kasper		
Admission Requirements	None		
Recommended Previous Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge Skills			
Personal Competence			
Social Competence			
Autonomy			
	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Examination	Written exam		
Examination duration and scale	zweistündig		
Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Comp General Engineering Science (German program, 7 semester): Core qualific Electrical Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory	•	pulsory

Course L0675: Electrica	Course L0675: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields		
Тур	Lecture		
Hrs/wk	3		
СР	5		
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42		
Lecturer	Prof. Manfred Kasper		
Language	DE		
Cycle	WiSe		
Content			
Literature	<ol> <li>M. Kasper, Skript zur Vorlesung Elektrotechnik 1, 2013</li> <li>M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004</li> <li>F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005</li> <li>A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008</li> </ol>		



Course L0676: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Manfred Kasper	
Language	DE	
Cycle	WiSe	
Content		
Literature	<ol> <li>Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013</li> <li>Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010</li> </ol>	



Courses				
Title Mechanics I (Statics) (L100	0	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Mechanics I (Statics) (L100	,	Recitation Section (small)	2	2
Mechanics I (Statics) (L100		Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous Knowledge	Solid school knowledge in mathematics and phys	sics.		
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can</li> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge in stereostatics.</li> </ul> The students can			
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation and apply it to the context of their own problems;</li> <li>apply basic statical methods to engineering problems;</li> <li>estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets.</li> </ul>			
Personal Competence				
Social Competence	The students can work in groups and support each	ch other to overcome diffic	ulties.	
Autonomy	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 Lect	ure 70		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Core qualification: Compulsory         General Engineering Science (German program, 7 semester): Core qualification: Compulsory         e Civil- and Environmental Engineering: Core qualification: Compulsory         a Mechanical Engineering: Core qualification: Compulsory         Mechanical Engineering: Core qualification: Compulsory         Mechatronics: Core qualification: Compulsory         Naval Architecture: Core qualification: Compulsory			



Course L1001: Mechanics I (Statics)		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
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).	

ourse L1002: Mechanic	cs I (Statics)
Тур	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	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 L1003: Mechanics I (Statics)		
Тур	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	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 M0850: Ma	thematics I			
Courses				
<b>Title</b> Analysis I (L1010)		<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 2
Analysis I (L1012) Analysis I (L1013) Linear Algebra I (L0912)		Recitation Section (small) Recitation Section (large) Lecture	1 1 2	1 1 2
Linear Algebra I (L0912) Linear Algebra I (L0913) Linear Algebra I (L0914)		Recitation Section (small) Recitation Section (large)	2 1 1	2 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Previous Knowledge	School mathematics			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concept them using appropriate examples.</li> <li>Students can discuss logical connillustrating these connections with th</li> <li>They know proof strategies and can</li> </ul>	ections between these conce e help of examples.	-	
Skills	<ul> <li>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.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work togethe common language.</li> <li>In doing so, they can communicate partners. Moreover, they can design peers.</li> </ul>	new concepts according to the	needs of th	neir cooperating
Autonomy	<ul> <li>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.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 128, Study Time in	Lecture 112		
Credit points				
-	Written exam			
Examination duration and scale	60 min (Analysis I) + 60 min (Linear Algebra	l)		



Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
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Course L1010: Analysis I		
Тур	Lecture	
Hrs/wk	2	
СР	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	<ul> <li>Foundations of differential and integrational calculus of one variable</li> <li>statements, sets and functions</li> <li>natural and real numbers</li> <li>convergence of sequences and series</li> <li>continuous and differentiable functions</li> <li>mean value theorems</li> <li>Taylor series</li> <li>calculus</li> <li>error analysis</li> <li>fixpoint iteration</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	

Course L1012: Analysis	ourse L1012: Analysis I	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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 L1013: Analysis	ourse L1013: Analysis I		
Тур	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		

ourse L0912: Linear Al	gebra I	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>vectors: intuition, rules, inner and cross product, lines and planes</li> <li>general vector spaces: subspaces, Euclidean vector spaces</li> <li>systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants</li> </ul>	
Literature	<ul> <li>T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009</li> <li>W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO- Verlag, Alsdorf 1994</li> <li>W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>	

Course L0913: Linear Al	ırse L0913: Linear Algebra I	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



se L0914: Linear Algebra I	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Π



Courses				
Title		Turn	Hrs/wk	СР
Physics for Engineers (L036	37)	<b>Typ</b> Lecture	2	3 3
	lem Solving Course) (L0368)	Recitation Section (small)	1	1
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Calculus and linear algebra on high s</li> <li>Physics on high school level</li> </ul>	school level		
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.			
Skills	Students can relate physics topics to technical problems. Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving courses.			
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Credit points	4			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core qualification: Compulsory			



Course L0367: Physics for Engineers		
Typ Lecture		
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Manfred Eich	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Kinematics and dynamics</li> <li>Work, Energy, momentum</li> <li>Rotatory Motion, moments of inertia</li> <li>Gravitation</li> <li>Special Theory of Relativity</li> <li>Oscillations</li> <li>Waves</li> <li>Geometrical optics</li> <li>Wave optics</li> <li>Matter waves</li> <li>Fundamentals of quantum mechanics</li> </ul>	
Literature	<ul> <li>Giancoli, Physics for Scientists &amp; Engineers Vol. 1, 2, Pearson</li> <li>Halliday/Resnik/Walker, <i>Fundamentals of physics</i>, Wiley</li> <li>K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), <i>Understanding Physics</i>, Wiley</li> <li>Gerthsen/Vogel, <i>Physik</i>, Springer Verlag</li> <li>Hering/Martin/Stohrer, <i>Physik für Ingenieure</i>, VDI-Verlag</li> </ul>	

Course L0368: Physics f	ourse L0368: Physics for Engineers (Problem Solving Course)		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Manfred Eich		
Language	DE		
Cycle	WiSe		
Content	see lecture Physics for Engineers		
Literature	see lecture Physics for Engineers		



Courses				
Title		Тур	Hrs/wk	СР
Chemistry I (L0460)		Lecture	2	2
Chemistry I (L0475)		Recitation Section (large)	1	1
Chemistry II (L0465)		Lecture	2	2
Chemistry II (L0476)		Recitation Section (large)	1	1
	Dr. Dorothea Rechtenbach			
Admission Requirements	none			
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students have reache	ed the following learning	results	
Professional				
Competence				
Knowledge	The students are able to name and to describe basic principles and applications of general chemistry (structure of matter, periodic table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorganic chemistry (acid/base, pH-value, salts, solubility redox, metals) and organic chemistry (aliphatic hydrocarbons, functional groups, carbonyl compounds? aromates, reaction mechanisms, natural products, synthetic polymers). Furthermore students are able to explain basic chemical terms.			
Skills	After successful completion of this module students are able to describe substance groups an chemical compounds. On this basis, they are capable of explaining, choosing and applying specifi methods and various reaction mechanisms.			
Personal Competence				
Social Competence	Students are able to take part in discussions on chemical issues and problems as a member of an interdisciplinary team. They can contribute to those discussion by their own statements.			
Autonomy	After successful completion of this module students are able to solve chemical problems independently by defending proposed approaches with arguments. They can also document thei approaches.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
-	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



Course L0460: Chemist	ry I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christoph Wutz
Language	DE
Cycle	WiSe
Content	<ul> <li>Structure of matter</li> <li>Periodic table</li> <li>Electronegativity</li> <li>Chemical bonds</li> <li>Solid compounds and solutions</li> <li>Chemistry of water</li> <li>Chemical reactions and equilibria</li> <li>Acid-base reactions</li> <li>Redox reactions</li> </ul>
Literature	<ul> <li>Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure</li> <li>Kickelbick: Chemie für Ingenieure (Pearson)</li> <li>Mortimer: Chemie. Basiswissen der Chemie.</li> <li>Brown, LeMay, Bursten: Chemie. Studieren kompakt.</li> </ul>

Course L0475: Chemistr	urse L0475: Chemistry I	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Dorothea Rechtenbach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0465: Chemist	ry II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christoph Wutz
Language	DE
Cycle	WiSe
Content	<ul> <li>Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,</li> <li>Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars</li> <li>Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction</li> <li>Practical applications and examples</li> </ul>
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure - Kickelbick: Chemie für Ingenieure (Pearson) - Schmuck: Basisbuch Organische Chemie (Pearson)

Course L0476: Chemist	urse L0476: Chemistry II	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Dorothea Rechtenbach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Г



Courses					
Title		Тур	Hrs/wk	СР	
Programming in C (L0083)		Lecture	1	1	
Programming in C (L1488)		Practical Course	1	1	
Module Responsible	Prof. Siegfried Rump				
Admission Requirements	None				
Recommended	Elementary PC handling skills				
	Elementary mathematical skills				
Educational Objectives	After taking part successfully, students have	e reached the following lear	ning results		
Professional Competence					
	The students know by heart the basic synta purpose.	x of C programming as well	as its meaning, i	ntent and	
	They know the fundamental components and principles of elementary procedural programming based on C programming and can explain them:				
Knowledge	<ul> <li>basic data types (integers, floating point n</li> <li>advanced data types (pointers, arrays, str</li> <li>operators (arithmetical operations, logical</li> <li>control flow (choice, loops, jumps, condition</li> <li>functions and macros</li> <li>important standard libraries and functions</li> <li>recursion</li> <li>linked lists</li> </ul>	ngs, composed data types, operations, bit operations) onal compilation)	type conversion)		
	The students are prepared for continuing C++.	programming lectures like	object oriented p	programming	
	The students know how to use an integrate so that they can write, store, compile and e	-	t for C programm	ing on a PC	
	Using their knowledge they are able to read and understand given C Programs.				
Skills	They can solve simple algorithmic problem in C language.	s on their own and can mod	el and program t	heir solution	
	The students are able to solve selected exe mechanics, electrical engineering or physic		-		
Personal Competence					
	The students are able to work in small tean programming errors and to present their re	• •	ks, to identify and	l analyze	
Social Competence	They are able to explain simple phenomena to each other directly at the PC.				
	The students prepare themselves using the programming exercises on their own.	given teaching material an	d solve the giver	1	
Autonomy	Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience.				
	For details beyond the scope of the lecture literature and / or by supplementary own re		ves using the sta	ited	
Workload in Hours	Independent Study Time 32, Study Time in	Lecture 28			
Credit points					
Examination	Written elaboration				



Examination duration and scale	1-2 coding tasks weekly
_	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory

Course L0083: Program	ming in C
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE/EN
Cycle	WiSe
Content	<ul> <li>C-Programming:</li> <li>1. basic data types (integers, floating point numbers, characters, boolean values)</li> <li>2. advanced data types (pointers, arrays, strings, composed data types, type conversion)</li> <li>3. operators (arithmetical operations, logical operations, bit operations)</li> <li>4. control flow (choice, loops, jumps, conditional compilation)</li> <li>5. functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers)</li> <li>6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)</li> <li>7. example programs for technical and mathematical applications</li> </ul>
Literature	<ul> <li>Kernighan, Brian W (Ritchie, Dennis M.;)</li> <li>The C programming language</li> <li>ISBN: 9780131103702</li> <li>Upper Saddle River, NJ [u.a.] : Prentice Hall PTR, 2009</li> <li>Sedgewick, Robert</li> <li>Algorithms in C</li> <li>ISBN: 0201316633</li> <li>Reading, Mass. [u.a.] : Addison-Wesley, 2007</li> <li>Kaiser, Ulrich (Kecher, Christoph.;)</li> <li>C/C++: Von den Grundlagen zur professionellen Programmierung</li> <li>ISBN: 9783898428392</li> <li>Bonn : Galileo Press, 2010</li> <li>Wolf, Jürgen</li> <li>C von A bis Z : das umfassende Handbuch</li> <li>ISBN: 3836214113</li> <li>Bonn : Galileo Press, 2009</li> </ul>

Course L1488: Program	burse L1488: Programming in C	
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
• •	ernating Current Networks and Basic Devices (L0178) ernating Current Networks and Basic Devices (L0179)	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 5 1
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
	Electrical Engineering I			
Recommended Previous Knowledge	Mathematics I Direct current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence		amental theories principl	es and met	hods related t
Knowledge	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 complet 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.			
Skills	Students are capable of calculating parameters within simple electrical networks at alternatin currents by means of a complex notation for voltages and currents. They can appraise the fundament effects that may occur within electrical networks at alternating currents. Students are able to analyz 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 a electrical power supply (transformer, transmission line, compensation of reactive power, multiphas system) and are qualified to dimension their main features.			
Personal Competence				
Social Competence	Students are able to work together on subject re their results effectively (e.g. during a week of proje		s. They are	able to preser
Autonomy	Students are capable to gather necessary information from the references provided and relate tha 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).			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 - 150 minutes			
Assignment for the Following Curricula	General Engineering Science (German program) General Engineering Science (German program, Electrical Engineering: Core qualification: Compu	7 semester): Core qualific	-	oulsory



Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Тур	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
	- 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
Content	- 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
	M Alberte "Elektrotecknik" Deensen Obelium (0014)
	- 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)
Literature	- 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: Electrica	I Engineering II: Alternating Current Networks and Basic Devices
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	
Cycle	
	- 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
Content	- 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
	- 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)
Literature	- 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: Fu	Indamentals of Mechanical Er	ngineering Design		
Courses				
Title		Тур	Hrs/wk	СР
	al Engineering Design (L0258)	Lecture	2	3
Fundamentals of Mechanica	al Engineering Design (L0259)	Recitation Section (la	irge) 2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge		ics and production engineerin	g	
Educational Objectives	After taking part successfully, students h	ave reached the following lea	rning results	
Professional Competence		able to:		
Knowledge	<ul> <li>explain basic working principles and functions of machine elements,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are a</li> <li>accomplish dimensioning calculates transfer knowledge learned in the skills),</li> <li>recognize the content of technicates technically evaluate basic design</li> </ul>	ations of covered machine ele the module to new requireme al drawings and schematic ske	ents and tasks	(problem solving
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss the methods.</li> </ul>	technical information in the	lecture support	ed by activating
Autonomy	<ul> <li>Students are able to independent</li> <li>Students are able to acquire a content e.g. by using the video re</li> </ul>	additional knowledge and to		
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale	1120			
Assignment for the Following Curricula	General Engineering Science (German General Engineering Science (German Energy and Environmental Engineering General Engineering Science (English p General Engineering Science (English p Logistics and Mobility: Core qualification Mechanical Engineering: Core qualificat Mechatronics: Core qualification: Comp Naval Architecture: Core qualification II. E Technomathematics: Core qualification:	program, 7 semester): Core qu : Core qualification: Compulse program): Core qualification: C program, 7 semester): Core qu n: Compulsory tion: Compulsory ulsory compulsory Engineering Science: Elective	ualification: Com ory Compulsory Ialification: Com	



ανΤ	Lecture
Hrs/wk	
CP	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers
Language	
Cycle	
	Lecture
Content	<ul> <li>Introduction to design</li> <li>Introduction to the following machine elements <ul> <li>Screws</li> <li>Shaft-hub joints</li> <li>Rolling contact bearings</li> <li>Welding / adhesive / solder joints</li> <li>Springs</li> <li>Axes &amp; shafts</li> </ul> </li> <li>Presentation of technical objects (technical drawing)</li> </ul>
	<ul> <li>Exercise</li> <li>Calculation methods for dimensioning the following machine elements: <ul> <li>Screws</li> <li>Shaft-hub joints</li> <li>Rolling contact bearings</li> <li>Welding / adhesive / solder joints</li> <li>Springs</li> <li>Axis &amp; shafts</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktu Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Sprin Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>

Course L0259: Fundame	ourse L0259: Fundamentals of Mechanical Engineering Design		
Тур	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. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0696: Me	chanics II: Mechanics of Materi	als		
Courses				
<b>Title</b> Mechanics II (L0493) Mechanics II (L0494) Mechanics II (L1691)	TypHrs/wkCPLecture22Recitation Section (small)22Recitation Section (large)22			
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	none			
Recommended Previous Knowledge	Mechanics I			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence Knowledge				
Skills	The students apply the fundamental methods of elasto statics to simply engineering problems. The students estimate the validity and limitations of the introduced methods.			
Personal Competence				
Social Competence Autonomy	-			
	- Independent Study Time 96, Study Time in Lecture 84			
Credit points				
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German pro General Engineering Science (German pro Civil- and Environmental Engineering: Core Mechanical Engineering: Core qualification Mechatronics: Core qualification: Compulse Naval Architecture: Core qualification: Corr	gram, 7 semester): Core qualific e qualification: Compulsory n: Compulsory pry		pulsory



Course L0493: Mechanic	cs II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	stresses and strains Hooke's law tension and compression torsion bending stability buckling energy methods
Literature	K. Magnus, H.H. Müller -Slany, Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2005) D. Gross, W. Hauger, W. Schnell, J. Schröder, Technische Mechanik 1&2. 8. Auflage, Springer (2004). R.C. Hibbeler, Technische Mechanik 1&2. Pearson (2005)

Course L0494: Mechanic	ourse L0494: Mechanics II		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Benedikt Kriegesmann		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1691: Mechanic	rse L1691: Mechanics II	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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Module M0671: Te	chnical Thermodynamics I			
Courses				
Title Technical Thermodynamics Technical Thermodynamics Technical Thermodynamics	I (L0439)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 4 1 1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Mech	anics		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 <sup>st</sup> law of Thermodynamics and are aware about the limits of energy conversions according to 2 <sup>nd</sup> 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 anergy. 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 or equation and know the basics of two phase Thermodynamics.			
Skills	Students are able to calculate the internal energy well as work and heat for simple change of stat They are able to calculate state variables for an variables.	es and to use this calculate	ations for th	e Carnot cycle
Personal Competence				
Social Competence	The students are able to discuss in small groups	and develop an approach		
Autonomy	Students are able to define independently tasks well as to find ways to use the knowledge in pract		rom existing	knowledge a
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points				
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program) General Engineering Science (German program, Bioprocess Engineering: Core qualification: Com Energy and Environmental Engineering: Core qu General Engineering Science (English program): General Engineering Science (English program): Computational Science and Engineering: Specia Mechanical Engineering: Core qualification: Com Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsor Technomathematics: Specialisation III. Engineerin Process Engineering: Core qualification: Compul	7 semester): Core qualific pulsory alification: Compulsory Core qualification: Compu 7 semester): Core qualifica lisation Engineering Scier pulsory ry ng Science: Elective Comp	ation: Comp ulsory ation: Comp ices: Elective	ulsory



Course L0437: Technica	I Thermodynamics I
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	SoSe
Content	<ol> <li>Introduction</li> <li>Fundamental terms</li> <li>Thermal Equilibrium and temperature         <ol> <li>Thermal equation of state</li> <li>First law</li> <li>Heat and work</li> <li>First law for closed systems</li> <li>First law for open systems</li> <li>Equations of state and changes of state</li> <li>Changes of state</li> <li>Cycle processes</li> </ol> </li> <li>Second law         <ol> <li>Carnot process</li> <li>Examples</li> <li>Examples</li> </ol> </li> <li>Thermodynamic properties of pure fluids         <ol> <li>Fundamental equations of Thermodynamics</li> <li>Thermodynamic potentials</li> <li>Calorific state variables for arbritary fluids</li> <li>A state equations (van der Waals u.a.)</li> </ol> </li> </ol>
Literature	<ul> <li>Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009</li> <li>Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012</li> <li>Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993</li> </ul>

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



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



Module	M0851:	Mathematics II	

Courses				
Title	Тур	Hrs/wk	СР	
Analysis II (L1025)	Lecture	2	2	
Analysis II (L1026)	Recitation Section (large)	1	1	
Analysis II (L1027)	Recitation Section (small)	1	1	
Linear Algebra II (L0915)	Lecture	2	2	
Linear Algebra II (L0916)	Recitation Section (small)	1	1	
Linear Algebra II (L0917)	Recitation Section (large)	1	1	

Module Responsible	Prof. Anusch Taraz		
Admission Requirements	none		
Recommended Previous Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	<ul> <li>Students can name further concepts in analysis and linear algebra. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>		
Skills	<ul> <li>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.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>		
Personal Competence			
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>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.</li> </ul>		
Autonomy	<ul> <li>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.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>		
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112		
Credit points	8		
Examination	Written exam		
Examination duration and scale	160  min (Analysis II) + 60  min (1 near Algebra II)		
	1		



Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
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Course L1025: Analysis	ll				
Тур	Lecture				
Hrs/wk					
CP	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Dozenten des Fachbereiches Mathematik der UHH				
Language	DE				
Cycle	SoSe				
Content	<ul> <li>power series and elementary functions</li> <li>interpolation</li> <li>integration (proper integrals, fundamental theorem, integration rules, improper integrals, parameter dependent integrals</li> <li>applications of integration (volume and surface of bodies of revolution, lines and arc length, line integrals</li> <li>numerical quadrature</li> <li>periodic functions</li> </ul>				
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>				

Course L1026: Analysis	urse L1026: Analysis II			
Тур	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 L1027: Analysis	ourse L1027: Analysis II			
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	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 L0915: Linear Al	gebra II				
Тур	ecture				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner				
Language	DE				
Cycle	SoSe				
Content	<ul> <li>linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices</li> <li>linear regression: QR-decomposition, normal equations, linear discrete approximation</li> <li>eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition</li> <li>system of linear differential equations</li> </ul>				
Literature	<ul> <li>W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO- Verlag, Alsdorf 1994</li> <li>W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>				

rse L0916: Linear Algebra II		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0917: Linear Al	urse L0917: Linear Algebra II			
Тур	Recitation Section (large)			
Hrs/wk	1			
CP	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert			
Language	DE			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			



Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics II (L0449)		Lecture	2	4
Technical Thermodynamics II (L0450)		Recitation Section (large)	1	1
Technical Thermodynamics	s II (L0451) Recitation Section (small) 1 1			
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics, N	lechanics and Technical Thermo	dynamics I	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	g results	
Professional				
Competence Knowledge	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-powe 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.			
Skills	Students are able to use thermodynamic laws for the design of technical processes. Especially the 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 tank. They are able to transform a verbal formulated message into an abstract formal procedure.			
Personal Competence				
Social Competence	The students are able to discuss in small	groups and develop an approac	า.	
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge a well as to find ways to use the knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula				



Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory

Course L0449: Technical Thermodynamics II					
Тур	Lecture				
Hrs/wk	2				
СР	4				
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28				
Lecturer	Prof. Gerhard Schmitz				
Language	DE				
Cycle	WiSe				
Content	<ul> <li>8. Cycle processes</li> <li>7. Gas - vapor - mixtures</li> <li>10. Open sytems with constant flow rates</li> <li>11. Combustion processes</li> <li>12. Special fields of Thermodynamics</li> </ul>				
Literature	<ul> <li>Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009</li> <li>Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012</li> <li>Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993</li> </ul>				

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

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



Module M0959: Me	chanics III (Hydrostatics, Kinematics	s, Kinetics I)			
Courses					
Title	Typ Hrs/wk CP				
Mechanics III (Hydrostatics	, Kinematics, Kinetics I) (L1134)	Lecture	3	3	
	, Kinematics, Kinetics I) (L1135)	Recitation Section (small)	2	2	
Mechanics III (Hydrostatics	, Kinematics, Kinetics I) (L1136)	Recitation Section (large)	1	1	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics I, II, Mechanics I (Statics)				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results		
Professional Competence					
	The students can				
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge in stereostatics.</li> </ul>				
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;</li> <li>apply basic hydrostatical, kinematic and kinetic methods to engineering problems;</li> <li>estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets.</li> </ul>				
Personal Competence					
Social Competence	The students can work in groups and support eac	h other to overcome difficu	ulties.		
Autonomy	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	e 84			
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				



Course L1134: Mechanics III (Hydrostatics, Kinematics, Kinetics I)		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	Hydrostatics Kinematics • Kinematics of points and relative motion • Motion of point systems and rigid bodies Dynamics • Terms • Fundamental equations • Motion of the rigid body • Dynamics of gyroscopes	
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).	

Тур	Recitation Section (small)
Hrs/wk	2
СР	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

Course L1136: Mechanic	ourse L1136: Mechanics III (Hydrostatics, Kinematics, Kinetics I)	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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	



## Module M0853: Mathematics III

## Courses

Courses			
Title	Тур	Hrs/wk	СР
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. Anusch Taraz
Admission Requirements	
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<ul> <li>Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>
Skills	<ul> <li>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.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>
Personal Competence	
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>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.</li> </ul>
Autonomy	<ul> <li>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.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
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): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
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Course L1028: Analysis III		
Тур	Lecture	
Hrs/wk	2	
СР	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	<ul> <li>Main features of differential and integrational calculus of several variables</li> <li>Differential calculus for several variables</li> <li>Mean value theorems and Taylor's theorem</li> <li>Maximum and minimum values</li> <li>Implicit functions</li> <li>Minimization under equality constraints</li> <li>Newton's method for multiple variables</li> <li>Double integrals over general regions</li> <li>Line and surface integrals</li> <li>Theorems of Gauß and Stokes</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	

Course L1029: Analysis	urse L1029: Analysis III	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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	ourse L1030: Analysis III	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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: Different	ial Equations 1 (Ordinary Differential Equations)
Тур	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	<ul> <li>Main features of the theory and numerical treatment of ordinary differential equations</li> <li>Introduction and elementary methods</li> <li>Exsitence and uniqueness of initial value problems</li> <li>Linear differential equations</li> <li>Stability and qualitative behaviour of the solution</li> <li>Boundary value problems and basic concepts of calculus of variations</li> <li>Eigenvalue problems</li> <li>Numerical methods for the integration of initial and boundary value problems</li> <li>Classification of partial differential equations</li> </ul>
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Тур	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: Different	urse L1033: Differential Equations 1 (Ordinary Differential Equations)	
Тур	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 M1273: Ac	Ivanced Internship GES		
Courses			
Title	Typ Hrs/wk CP		
Module Responsible	Prof. Gerhard Schmitz		
Admission Requirements	None		
Recommended Previous Knowledge	1150 ECTS Credits in General Engineering Science		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students of the different specialisations get experiences in typical scope of duties of engineers, who are working in a development division, planning division or in the management of a company. In the framework of this environment the knowledge from university can used a first time for real engineering tasks.		
Skills	Students of the different specialisations should be integrated in typical day's work. By this they are learning typical tasks and functions of engineers. They are able to structure and organize their working day and to finish tasks in a certain time.		
Personal Competence			
Social Competence	Students are able to cooperate with co-workers in a company and to understand the language of engineers.		
Autonomy	Students can finish own tasks.		
Workload in Hours	Independent Study Time 540, Study Time in Lecture 0		
Credit points	18		
Examination	Written elaboration (accord. to Internship Regulations)		
Examination duration and scale	see Internship Regulations		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory		



## **Specialization Civil Engineering**

In the specialization "civil engineering" the graduates attain the basic competences to plan, build and repair structures like bridges and tunnels, structures in hydraulic engineering, as well as industrial and housing construction. The specialization allows the transition to the master program civil engineering.

Module M0580: Pr	inciples of Building Materials and B	uilding Physics		
Courses				
Title		Тур	Hrs/wk	СР
Building Physics (L0217)		Lecture	2	2
Building Physics (L0219)		Recitation Section (large)	1	1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materia		Lecture	2	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of physics, chemistry and mathemat	ics from school		
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.			
Skills	The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.			
Personal Competence				
Social Competence	The students are able to support each other to le	earn the very extensive spe	cialist knowl	edge.
Autonomy	The students are able to make the timing and th a very extensive field.	e operation steps to learn	the speciali	st knowledge o
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
	General Engineering Science (German p Engeneering: Compulsory General Engineering Science (German prog Compulsory Civil- and Environmental Engineering: Core qua General Engineering Science (English program Compulsory General Engineering Science (English progr Compulsory Technomathematics: Specialisation III. Engineer	ram, 7 semester): Specia lification: Compulsory ): Specialisation Civil- and ram, 7 semester): Specia	lisation Civ Enviromenta lisation Civ	il Engineering al Engeneering



ourse L0217: Building Physics				
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Frank Schmidt-Döhl			
Language	DE			
Cycle	WiSe			
Content	Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection, noise protection			
Literature	Fischer, HM. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3			

se L0219: Building Physics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0247: Building	Course L0247: Building Physics	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0215: Principle	s of Building Materials
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	Structure of building materials Effects of action Fundamentals of mechanical behaviour Principles of metals Joining methods Corrosion
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8



Module M0740: Str	ructural Analysis I			
Courses				
<b>Title</b> Structural Analysis I (L0666) Structural Analysis I (L0667)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Mechanics I, Mathematics I			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	After successfully completing this module, stud analysis of statically determinate systems.	dents can express the bas	sic aspects	of linear fram
	After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.			
Personal Competence	Ctudente con			
Social Competence	<ul> <li>Students can</li> <li>participate in subject-specific and interdisciplinary discussions,</li> <li>defend their own work results in front of others</li> <li>promote the scientific development of colleagues</li> <li>Furthermore, they can give and accept professional constructive criticism</li> </ul>			
Autonomy	The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 Minuten			
	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



Course L0666: Structura	Il Analysis I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	<ul> <li>Statically determinate structural systems</li> <li>basics: statically determinacy, equilibrium, method of sections</li> <li>forces: determination of support reactions and internal forces</li> <li>influence lines of forces</li> <li>displacements: calculation of discrete displacements and rotations, calculation of deflection curves</li> <li>principle of virtual displacements and virtual forces</li> <li>work-engergy theorem</li> <li>differential equation of beam</li> </ul>
	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

Course L0667: Structura	rse L0667: Structural Analysis I	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Building Materials and Buildi	ng Chemistry (L0248)	Lecture	4	4
Building Materials and Buildin	ng Chemistry (L0249)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Module Principles of Building Materials	and Building Physics		
<b>Educational Objectives</b>	After taking part successfully, students I	nave reached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain the most important components, the manufacture, the structure, th most important characteristics of the mechanical behaviour and the corrosion behaviour, the materiate testing and the fields of utilization of all relevant building materials.			
Skills	The students are able to assess the usability of building materials for different applications and the select building materials according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concrete and to consider the mixture in respect to the actual rules and the connections between the characteristic concrete parameters. They are able to select suitable materials and mixtures to avoid damage processes.			
Personal Competence				
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge learning groups and to carry out exercises in small groups in the lab.			
Autonomy				
Workload in Hours	Independent Study Time 110, Study Tir	ne in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 stündige Klausur			
Assignment for the Following Curricula				



Course L0248: Building	Materials and Building Chemistry		
Тур	Lecture		
Hrs/wk	4		
СР	4		
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56		
Lecturer	Prof. Frank Schmidt-Döhl		
Language	DE		
Cycle	SoSe		
Content	Cementing materials, aggregates, admixtures and other components in mortar and concrete, concrete, durability of cement bonded materials, repair of concrete structures, steel, cast iron, non-ferrous metals, metal corrosion, timber, plastics, natural stone, synthetic stones, mortar, masonry, glass, bitumen		
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8 Henning, O.; Knöfel, D.: Baustoffchemie. ISBN 3-345-00799-1 Knoblauch, H.; Schneider, U.: Bauchemie. ISBN 3-8041-5174-4		

ourse L0249: Building Materials and Building Chemistry	
Recitation Section (small)	
1	
2	
Independent Study Time 46, Study Time in Lecture 14	
Prof. Frank Schmidt-Döhl, Klaus-Dieter Henk	
DE	
SoSe	
See interlocking course	
See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L0551)		Recitation Section (large)	2	2
Soil Mechanics (L1493)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended	Modules :			
Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reac	ned the following learning	results	
Professional				
Competence				
Knowledge	The students know the basics of soil mechanics as the structure and characteristics of soil, strest distribution due to weight, water or structures, consolidation and settlement calculations, as well a failure of the soil due to ground- or slope failure.			
Skills	After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight or influence of structures. They are are able to prove the usability (settlements) for shallow foundations.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	160 Minuten			
Assignment for the	General Engineering Science (German pr Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qual General Engineering Science (English program):	am, 7 semester): Specia	lisation Civ	vil Engineerir



Course L0550: Soil Mechanics		
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Structure of the soil</li> <li>Ground surveying</li> <li>Compstition and properties of the soil</li> <li>Groundwater</li> <li>One-dimensional compression</li> <li>Spreading of stresses</li> <li>Settlement calculation</li> <li>Consolidation</li> <li>Shear strength</li> <li>Earth pressure</li> <li>Slope failure</li> <li>Ground failure</li> <li>Suspension based earth tenches</li> </ul>	
Literature	<ul> <li>Vorlesungsumdruck, s. ww.tu-harburg.de/gbt</li> <li>Grabe, J. (2004): Bodenmechanik und Grundbau</li> <li>Gudehus, G. (1981): Bodenmechanik</li> <li>Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau</li> <li>Grundbau-Taschenbuch, Teil 1, aktuelle Auflage</li> </ul>	

Course L0551: Soil Mechanics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1493: Soil Mechanics		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0613: Re	inforced Concrete I			
Courses				
Title		Тур	Hrs/wk	СР
Project Seminar Concrete I Reinforced Concrete Design	. ,	Seminar Lecture	1 2	2 2
Reinforced Concrete Design		Recitation Section (large)	2	2
	Prof. Günter Rombach	(		
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge in structural analysis an	d building materials.		
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Competence		concrete construction and over	ain tha haa	ice of structural
Knowledge	The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and of structural members.			
Skills	The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.			
Personal Competence				
Social Competence				
Autonomy	The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the results.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	( 'will and Environmontal Engineering' ( 'ere gualitication' ( 'empulsery			



Course L0896: Project S	ourse L0896: Project Seminar Concrete I		
Тур	Seminar		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	SoSe		
Content	In the course of the project seminar, a simple structure is drafted and dimensioned.		
Literature			

Course L0303: Reinforce	ed Concrete Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	<ul> <li>The following subjects/contents are treated:</li> <li>history of concrete construction</li> <li>mechanical and physical-chemical properties od concrete and steel</li> <li>bond between concrete and reinforcement</li> <li>concepts for dimensioning, limit state models, structural safety</li> <li>design of linear members for tension and bending with and without axial force</li> </ul>
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!

Course L0305: Reinforced Concrete Design I		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title Structural Analysis II (L0673 Structural Analysis II (L0674		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mechanics I/II</li> <li>Mathematics I/II</li> <li>Differential Equations I</li> <li>Structural Analysis I</li> </ul>			
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence	After successful completion of this module,	students can express the ba	sic aspects	of linear fram
Knowledge	analysis of statically indeterminate systems.			
Skills	After successful completion of this module, construct influence lines of statically indermin			
Personal Competence				
Social Competence	<ul> <li>Students can</li> <li>participate in subject-specific and inte</li> <li>defend their own work results in front</li> <li>promote the scientific development of</li> <li>Furthermore, they can give and acception</li> </ul>	of others colleagues	icism	
Autonomy	The students are able to work in-term home enabled to self-assess their learning progres	-		back, they a
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following Curricula	General Engineering Science (German Engeneering: Compulsory General Engineering Science (German pr Compulsory Civil- and Environmental Engineering: Core of General Engineering Science (English progr	qualification: Compulsory	lisation Civi	I Engineerin



Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

Course L0673: Structural Analysis II		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Linear structural analysis: statically indeterminate systems</li> <li>force method</li> <li>slope-deflection method for sway and non-sway frames</li> <li>general displacement method and finite element method</li> </ul>	
Literature	Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 - Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004	

Course L0674: Structural Analysis II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0611: Ste	eel Structures I			
Courses				
Title Steel Structures I (L0299) Steel Structures I (L0300)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>СР</b> 3 3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Structural analysis I, Structural analysis II</li> <li>Mechanics I, Mechanics II</li> <li>Building Materials and Building Chemistry</li> <li>Principles of Building Materials and Building Physics</li> </ul>			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	<ul> <li>After passing this module students are able to</li> <li>give a summary of the security concept</li> <li>explain the priciples of the design process</li> <li>describe and illustrate the bhaviour of memers in tension, compression and bending</li> </ul> Students can rate and apply the material steel appropriately with respect to its properties and usage.			
Skills	They can use the security concept with respect to loads, forces and resistances.			
Personal Competence				
Social Competence	After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings.			
Autonomy				
	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6 Written exam			
Examination Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory			



Course L0299: Steel Str	uctures I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction to steel constructions</li> <li>Materials</li> <li>Design and security model</li> <li>Tension rods</li> <li>Beams (elsatic and plastic design</li> <li>Column design</li> <li>Bolted connections</li> </ul>
Literature	Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 • Band 1 Tragwerksplanung, Grundlagen • Band 2 Verbindungen und Konstruktionen

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Тур	Recitation Section (large)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Marcus Rutner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0728: Hy	draulic Engineering I			
Courses				
<b>Title</b> Hydrology (L0909)		<b>Typ</b> Lecture	Hrs/wk 1	<b>CP</b> 1
Hydrology (L0956)		Project-/problem-based Learning	1	2
Hydromechanics (L0615) Hydromechanics (L0616)		Lecture Recitation Section (large)	2 1	2 1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I, II and III Mechanik I und II			
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrologica water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and or established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.			
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems. In addition, the basic concepts of field – measurements of hydrological and hydrodynamic values car be described and the students are able to perform, analyze and assess respective measurements.			
Personal Competence Social Competence	The students are able to prepare and present technical presentations for given topics in groups.			
Autonomy	Students can provide each other with feedback and suggestions on their results. They are capable o reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	6			
Examination	Written exam			
	The duration of the examination is 2 hours. understanding of the lecture contents and c		s with respec	ct to the general
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromenta Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering Compulsory			



Course L0909: Hydrology		
Тур	Lecture	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	Introduction to basics of Hydrology: <ul> <li>Hydrological cycle</li> <li>Data acquisition</li> <li>Data analyses and statistical assessment</li> <li>Statistics of extremes</li> <li>Regionalization methods for hydrological values</li> </ul> Rainfall-run-off modelling on the basis of a unit hydrograph conceps	
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde	

urse L0956: Hydrolog	У
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde



Course L0615: Hydrome	echanics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	<ul> <li>Momentum Equation</li> <li>Application of conservation laws to flow conditions</li> </ul>
Literature	Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2 E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ hydraulik_tool/index.html) Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998. Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.

Course L0616: Hydrome	purse L0616: Hydromechanics		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Module M0628: Wa	ater Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (L0	251)	Lecture	1	1
Groundwater Hydrology (L0	252)	Recitation Section (large)	1	2
Water Management and Wa	ter Quality (L0366)	Lecture	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Mathemaics I to III; Water Engineeri	ng I, Chemistry		
Educational Objectives	After taking part successfully, studer	nts have reached the following learning	results	
Professional				
Competence				
Knowledge	quality. Typical aquifer types and the occuring flow and storage processes can be explain technically. They are able to derive the Darcy law and the mathematical description of flow process as well as their solution. They are in a position to explain the physical background of well hydrauli Fundamentals of solute transport can be reflected.			
Skills	Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues. They are in a position to rate water quality data and to set up hydrologic water balances. They are able to construct ground water contour lines and streamlines on the basis head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraul conductivities and storage coefficients.			
Personal Competence				
Social Competence	Students are able to help each othe	r solving case studies.		
Autonomy	Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula				



Course L0251: Groundw	ater Hydrology
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wilfried Schneider
Language	DE
Cycle	WiSe
Content	Hydrologic water bilance, aquifertyps, groundwater velocities, Darcy law, groundwater contour lines, storage capacity, flow equation, pumping tests, method of Beyer, solute transport in groundwater
Literature	Todd; K. (2005): Groundwater Hydrology Fetter, C.W. (2001): Applied Hydrogeology Hölting & Coldewey (2005): Hydrogeologie Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport

Course L0252: Groundw	ourse L0252: Groundwater Hydrology			
Тур	Typ Recitation Section (large)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Wilfried Schneider			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L0366: Water Management and Water Quality			
Тур	ecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Mathias Ernst		
Language	DE		
Cycle	ViSe		
Content	<ul> <li>The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview:</li> <li>Water balance, water availability, water scarcity, water recycling</li> <li>Water quality parameter (organic, inorganic), assessment and decision support tools.</li> </ul>		
Literature	<ul> <li>Teil Wasserwirtschaft:</li> <li>Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001</li> <li>Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011</li> <li>Pdf der Vorlesung</li> </ul>		



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible		, , , , , , , , , , , , , , , , , , ,		
Admission Requirements				
Recommended Previous Knowledge	Representation of signals and systems i	n time and frequency domain, Lap	lace transfor	m
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence			,	
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain arr implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain ar vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to their controller designs			·
Autonomy	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 Tim	e in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale				
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	n program, 7 semester): Specia	lisation Com	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory		



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

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Module M0631: Co	oncrete Structures II			
Courses				
Title Project Concrete Structures Concrete Structures II (L034 Concrete Structures II (L034	48)	<b>Typ</b> Project Seminar Lecture Recitation Section (large)	<b>Hrs/wk</b> 1 2 2	<b>CP</b> 1 3 2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Knowledge of loads on structures and co</li> <li>Basics of safety format are required.</li> <li>Knowledge in design of beams and colu</li> <li>Lecture 'Concrete Structures I'</li> </ul>			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional				
Competence Knowledge	The students know the basic principles which arev required for design of reinforced concrete structures. They know the various methods to estimate the member forces in simple one and two-way slabs.			
Skills	<ul> <li>The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.).</li> <li>The students can estimate the member forces of simple slabs.</li> <li>The students know the content and the layout of a structural analysis</li> </ul>			
Personal Competence				
Social Competence	Cooperation in a project work, where they desi	ign in a team a real concre	te building	and present the
Autonomy				
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination Examination duration	Written exam			
and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German p Engeneering: Compulsory General Engineering Science (German prog Elective Compulsory Civil- and Environmental Engineering: Core qua General Engineering Science (English program Compulsory General Engineering Science (English prog Elective Compulsory	alification: Compulsory (): Specialisation Civil- and	lisation Cir	vil Engineering: al Engeneering:



Course L0894: Project C	ourse L0894: Project Concrete Structures II	
Тур	Project Seminar	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	Design of a truss structure	
Literature	Skript zur Lehrveranstaltung "Stahlbetonbau II"	

Course L0348: Concrete	e Structures II
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Design of concrete members for shear, punching and torsion</li> <li>Design for serviceability limit state (durability): crack- and deflection control</li> <li>Detailing</li> <li>Introduction in the design of plates</li> <li>Layout and content of a structural design</li> </ul>
Literature	<ul> <li>Vorlesungsumdrucke</li> <li>König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010</li> <li>Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011</li> <li>Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997</li> <li>Grasser E. ,Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 1: Allgemeine Bemessungsregeln für den Hochbau.</li> </ul>

Course L0349: Concrete	Course L0349: Concrete Structures II	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
A duais a io n	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are lifted	examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly.
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

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	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory
	Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	r Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Compute	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Module M0755: Ge	otechnics II			
Courses				
<b>Title</b> Foundation Engineering (L05 Foundation Engineering (L05 Foundation Engineering (L14	553)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
			-	-
Module Responsible Admission Requirements				
Recommended Previous Knowledge	Modules: • Mechanics I-II • Geotechnics I			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	geotecnnical structures.			
Skills	<ul> <li>After successful completion of the module the students are able to:</li> <li>verificate the stability and usability of foundations,</li> <li>know individual methods of ground improvement and apply them in their range of application,</li> <li>design retaining walls.</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra Elective Compulsory Technomathematics: Specialisation III. Engineerin	am, 7 semester): Specia fication: Compulsory Specialisation Civil- and m, 7 semester): Specia	lisation Civ Enviroment	vil Engineering al Engeneering



Course L0552: Foundation Engineering	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	<ul> <li>Shallow foundations</li> <li>Pile foundations</li> <li>Ground improvement</li> <li>Retaining walls</li> <li>Underpinning</li> <li>Groundwater Conservation</li> <li>Cut-off Walls</li> </ul>
Literature	<ul> <li>Vorlesung/Übung s. www.tu-harburg.de/gbt</li> <li>Grabe, J. (2004): Bodenmechanik und Grundbau</li> <li>Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau</li> <li>Grundbau-Taschenbuch, neueste Auflage</li> </ul>

Course L0553: Foundation	urse L0553: Foundation Engineering	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1494: Foundation Engineering	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



## Module M0878: Applications in Civil and Environmental Engineering

Title	Тур	Hrs/wk	СР
Applied Numerical Methods (L0211)	Seminar	3	3
Applied Structural Dynamics (L0791)	Lecture	2	2
Building Information Modeling (L1903)	Lecture	1	1
Building Information Modeling (L1904)	Project-/problem-based Learning	2	2
Computational Analysis of Structures (L0370)	Lecture	2	3
Introduction in Statitics with R (L0286)	Lecture	1	1
Introduction in Statitics with R (L0776)	Recitation Section (large)	1	1
Principles of Geomatics (L0470)	Lecture	2	2
Principles of Geomatics (L0471)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)	Practical Course	2	2
Practical Course in Drinking Water Chemistry (L1744)	Practical Course	1	2
Projects II (L1228)	Project Seminar	2	2
Fire Protection and Prevention (L0472)	Lecture	2	2

Module Responsible	
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are at home doing with typical applications of the study programme.
	The students are able to use the methods that are provided during the lectures for practical questions. They are able to work in the learnt methods into new forms of application independently".
Skills	
Personal Competence	
Social Competence	According to the course chosen students are able to perform tasks or to conduct a project in teams. If so, they can present, discuss and document results accordingly.
Autonomy	According to the course chosen individual students can plan and document tasks and work flow for themselves or for the team.
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory



ourse L0211: Applied N	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	4 schriftliche Ausarbeitungen und erfolgreiche Bearbeitung von semesterbegleitenden Vips
Lecturer	Dr. Gernod Deckelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Possible methods to solve engineering problems</li> <li>Application of numerical methods</li> <li>Basic steps in the finite element method</li> <li>Requests for the geometric modell</li> <li>Linear, quadratic and cubic elements</li> <li>Minimum total potential energy formulation and verification of results</li> <li>Non-linear problems and error-estimation procedures</li> <li>Application of ANSYS to solve typical problems in the fields of civil engineering</li> </ul>
Literature	Müller, Günter (Groth, Clemens) FEM für Praktiker ISBN: 3816926851 (Kt.) ISBN: 978-3-8169-2685-6 Renningen : expert-Verl, 2007 Groth, Clemens (Müller, Günter) FEM für Praktiker ISBN: 3816918581 Renningen : Expert-Verl, 2001 Chandrupatla, Tirupathi R (Belegundu, Ashok D.; Ramesh, T.) Introduction to finite elements in engineering ISBN: 0132162741 (United States ed.) ISBN: 9780132162746 (United States ed.) ISBN: 027376368 (International ed.) ISBN: 9780273763680 (International ed.) Upper Saddle River, NJ [u.a.] Prentice Hall, 2012 Gvk Moaveni, Saeed Finite element analysis : theory and application with ANSYS ISBN: 0132416514 ISBN: 9780132416511 Upper Saddle River, NJ Pearson Prentice-Hall, 2008 Gvk Patankar, Suhas V Numerical heat transfer and fluid flow ISBN: 0891165223 New York [u.a.] : Hemisphere Publ. Co, 1980 Bathe, Klaus-Jürgen (Zimmermann, Peter) Finite-Elemente-Methoden ISBN: 3540668063 (Gb.) ISBN: 978-3-540-66806-0 Berlin [u.a.] : Springer, 2002



Course L0791: Applied S	Structural Dynamics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	15 min
Lecturer	Dr. Kira Holtzendorff
Language	DE
Cycle	WiSe
Content	The lecture gives an introduction into the classical structural dynamics, whereas the focus lies on the practical applications. The theoretical basics are worked out in order to apply them for typical issues in practice. For an effective vibration isolation due to vibration excitations by e.g. railway traffic, operating machines oder moving people, different structural measures are presented. The lecture is completed by performing examples of vibration measurements as well as interactive dynamic experiments in the laboratory. The following topics are covered: Particular features in structural dynamics Basic terms of time-dependent excitations Free vibrations (natural frequencies) Induced vibrations Impact excitations of structures Methods of amplitude reduction (vibration isolation) Introduction to soil dynamics Vibration measurements and requirements for vibration protection Vibrations induced by people
Literature	Helmut Kramer: Angewandte Baudynamik, Ernst & Sohn Verlag, 2. Auflage 2013 Christian Petersen: Dynamik der Baukonstruktionen, Vieweg Verlag, 2. Auflage von 2000



course L1903: Building Information Modeling	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	siehe Modulhandbuch
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe/SoSe
Content	Designing of basic drawing elements (e. g. line, circle, arc,) Modifying of construction elements (e. g. copy, mirror, extend, trim, fillet,) Administration and use of the program structure Dimensioning of design and structural elements Inscribing of design and structural elements Hatching of structural elements Creating and preparing of printable drawings Aims and procedure of building information modeling
Literature	-

ourse L1904: Building Information Modeling	
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Schriftliche Ausarbeitung
Examination duration and scale	siehe Modulhandbuch
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0370: Computa	tional Analysis of Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	60 min
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>basics of the Finite Element Method, Spreadsheets</li> <li>basics of software 'SOFiSTiK'</li> <li>modeling of an arbitrary cross-section</li> <li>modeling of an arbitrary 2D truss structure incl. loads</li> <li>Teddy; usage of global and local variables</li> <li>design of a concrete section</li> <li>modeling of a T-beam bridge by means of a grillage system</li> <li>modeling and design of a rectangular slab</li> <li>building models</li> </ul>
Literature	<ul> <li>Skript zu Vorlesung</li> <li>Tutorials von SOFiSTiK</li> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>



ανΤ	Lecture
Hrs/wk	
CP	
	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and scale	60 min
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
	Introduction to R
	Graphics with R
	Descriptive Statistic (Boxplot, Percentiles, outliers)
	Propability (Combinatorics, relative frequency, dependand probability)
Content	random numbers and distibutions (confidence interval, uniform and discrete distributions, tes distributions (t-F-X <sup>2</sup> -distribiution))
	Correlation and Regression analysis (Confidence interval of calibration curves, linearity)
	Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test)
	Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)
	Introduction time series (tseries)
	Introduction cluster analysis (k-means)
	Regionales Rechenzentrum für Niedersachsen
	Statistik mit R
	Grundlagen der Datenanalyse , 2013
	Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf
	mp.//www.wiwi.um-bielelelu.ue/illeaumin/ement/ironn/nanui_grundausbildung/statskipt.pui
	und die dazugehörige Aufgabensammlung
	http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf
Literature	Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge von Toutenburg, Helge 2008
	http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran project.org/doc/contrib/Short-refcard.pdf
	Grafiken und Statistik in R von Andreas Plank
	Nachschlage Skript mit Beispielen: http://www.geo.fr berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fu- berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf



Course L0776: Introduct	Course L0776: Introduction in Statitics with R	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form		
Examination duration and scale	siehe Vorlesung	
Lecturer	Dr. Joachim Behrendt	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0470: Principle	s of Geomatics	
Typ Lecture		
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and scale	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur	
Lecturer	Prof. Peter Andree	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Overview of geomatics in general</li> <li>Units of measurements</li> <li>Generating of topographical maps</li> <li>Basic surveying instruments and handling</li> <li>Geodetic surveying lines and verification of measurements</li> <li>Methods of horizontal survey</li> <li>Components of geodetic surveying instruments</li> <li>Height determination</li> <li>Setting out points</li> <li>Topographical survey</li> <li>Directions and angles</li> <li>Determination of coordinates</li> <li>Traversing</li> <li>Basics on surveying and positioning with GNSS</li> </ul>	
Literature	Andree, P.:       Grundlagen der Geomatik (Skript)         Resnik, B. / Bill, R.:       Vermessungskunde für den Planungs- Bau- und Umweltbereich,         Wichmann-verlag       Vermessungskunde und Grundlagen der Statistik für das Bauwesen,         Witte, B. / Sparla, P.:       Vermessungskunde und Grundlagen der Statistik für das Bauwesen,         Wichmann-Verlag       Gruber, F.J. / Joeckel, R.:         Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag	



Course L0471: Principles of Geomatics	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	
Lecturer	Prof. Peter Andree
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0125: Numeric and Matlab	
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	Lo Libundsautdaben lewells mit Lestat am Ende
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>
Literature	Literatur (Software-Teil): <ol> <li>Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007</li> <li>Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de</li> <li>Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>



Course L1744: Practical	Course in Drinking Water Chemistry
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	6 Versuchsprotokolle
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	<ul> <li>IMax.12 students!</li> <li>The students learn basic experimental work in the laboratory. The experiments give an overview about the most important chemical analysis methods of drinking water. This includes sampling, photometric measurement, complexometric titration as well as acid/base titration. The experiments are strongly related to the processes in drinking water treatment and water distribution (e. g. removal of iron and manganese, softening and conditioning). Instrumental analytics is not subject of this practical course.</li> <li>1. Day: Introduction, safety instructions</li> <li>2. Day: Electrical conductivity, Saturation with respect to calcite, hardness</li> <li>3. Day: Organic carbon, iron, acid and base neutralization capacity</li> <li>4. Day: Writing protocols of experiments</li> <li>5. Day: Evaluation of the protocols</li> </ul>
Literature	Siehe Skript. See Script.

Course L1228: Projects	Course L1228: Projects II	
Тур	Project Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	ca. zehnminütige Präsentation	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	Excursions to different construction and enviromental projects.	
Literature	keine	



Course L0472: Fire Prot	ection and Prevention
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	20 min
Lecturer	Andreas Kattge
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction</li> <li>fire in residential and office buildings</li> <li>town planning: location of residential, office and industry areas, location of fire stations</li> <li>design of roads an water pipes</li> <li>explosions</li> </ul>
Literature	• Schneider U. : Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002



Module M0829: Fo	undations of Management			
Courses				
Title	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None	ione		
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busin	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most importar aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, informatio management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>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 <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	i			
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	l
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture
	concra Engineering opened (English program, 7 semester). Specialisation wavar Aldilledulle

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General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
 Process Engineering: Core gualification: Compulsory



<b>T.</b>	Lecture		
тур Hrs/wk			
CP			
	5 Independent Study Time 48, Study Time in Lecture 42		
WOI KIOAU III HOUIS			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathri Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chai Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateg information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



Module M0579: Str	ructural Design			
Courses				
<b>Title</b> Basics of Structural Design (L0205) Exercises in Structural Design (L0208)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 1	<b>CP</b> 1 1
Seminar in Structural Design	n (L0209)	Project-/problem-based Learning	2	4
Module Responsible	Dr. Gernod Deckelmann			
Admission Requirements	None			
Recommended Previous Knowledge		erials and Building Physics"		
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>to define the basics of building regulations law</li> </ul>			
Skills	<ul> <li>After attending the course students are able</li> <li>to evaluate development plans and to convert the main objectivs of building regulation laws to a architect's plan</li> <li>to decide which building components should be used to get a correcct building enevelope and a sufficient building stability</li> <li>to proof the moisture behaviour, the energy consumption, the acoustic protection and the fire control of a construction</li> <li>to plot the results of drafts and decisions</li> </ul>			
Personal Competence	After attending the course students are able			
Social Competence	<ul> <li>to work in a team and to persent the results of the team work</li> </ul>			
Autonomy	<ul> <li>After attending the course students are able</li> <li>to control and improve their knowledge with the help of weekly presentations (lecture room) and tests (STUD.IP)</li> <li>to divide the main task in different parts, to deduce the needed knowledge and to schedule the different work steps</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	160 minutes written test			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory			



Tvp	Lecture	
Hrs/wk		
CP		
	I · Independent Study Time 2, Study Time in Lecture 28	
	Dr. Gernod Deckelmann	
Language		
	SoSe	
Oycic		
Content	<ul> <li>Basics of building regulation laws</li> <li>Foundation of buildings</li> <li>Sealing of basements</li> <li>facades</li> <li>Ceilings</li> <li>Roofs</li> <li>Windows, doors and post-and-beam constructions</li> <li>Staircases</li> <li>Basics of strucural engineering design</li> <li>Structural fire prevention</li> <li>Optional tests on STUD.IP</li> </ul>	
Literature	<ul> <li>Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</li> <li>Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wänd Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</li> <li>Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda</li> </ul>	



rse L0208: Exercise	s in Structural Design
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Gernod Deckelmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Constructing a small individuell building in groups of 4 persons</li> <li>Analysing the informations and the contents of development plans and building regulation laws</li> <li>Design of building components and approving of the functionality (sealing, facades, roofs)</li> <li>Design and approve of the functionality of the component interconnections</li> <li>Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection ar fire control</li> <li>Assessing the building stability</li> <li>Basics of building services</li> <li>Each week the results of different work steps are presented in oral and written form</li> </ul>
Literature	<ul> <li>Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</li> <li>Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wänd Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</li> <li>Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROI Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied : Werner, 2006</li> <li>Wendehorst, Reinhard (Wetzell, Otto W.;; Baumgartner, Herwig.; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.]: Teubner Berlin [u.a.]: Beuth, 2007</li> <li>Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Ma und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.)</li> <li>Wiesbaden : Vieweg + Teubner, 2009</li> </ul>



rse L0209: Seminar	in Structural Design
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Gernod Deckelmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Constructing a small individuell building in groups of 4 persons</li> <li>Analysing the informations and the contents of development plans and building regulation laws</li> <li>Design of building components and approving of the funcionality (sealing, facades, roofs)</li> <li>Design and approve of the funcionality of the component interconnections</li> <li>Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control</li> <li>Assessing the building stability</li> <li>Basics of building services</li> <li>Each week the results of different work steps are presented in oral and written form</li> </ul>
Literature	<ul> <li>Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</li> <li>Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wänd Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</li> <li>Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROI Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied : Werner, 2006</li> <li>Wendehorst, Reinhard (Wetzell, Otto W.;; Baumgartner, Herwig.; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.]: Teubner Berlin [u.a.]: Beuth, 2007</li> <li>Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Ma und Zie! ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.)</li> <li>Wiesbaden : Vieweg + Teubner, 2009</li> </ul>

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Courses				
Title		Тур	Hrs/wk	СР
Wastewater Disposal (L027)	6)	Lecture	2	2
Wastewater Disposal (L027	3)	Recitation Section (large)	1	1
Drinking Water Supply (L030		Lecture	2	1
Drinking Water Supply (L030	08)	Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge on Chemistry and Bio</li> <li>Hydraulics of pipe systems and open c</li> <li>Basic knowledge on water manageme</li> <li>Basic knowledge on Environmental Le</li> </ul>	hannels nt: water quantity and water o	quality	
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastructures. They can prese the derivation and detailed explanation of important standards for the design of drinking water supp and wastewater disposal systems in Germany and they are capable of reproducing the releva empiricals assumptions and scientific simplifications. The students are able to present and discus sanitary engineering processes and the technologies used for drinking and wastewater treatmer They can also assess existing problems in the field of sanitary engineering by considering legal, ris and saftey aspects. Furthermore, they know how to draft the features and effectiveness of importar technologies of the future such as high- and low-pressure membrane filtration systems and technique for the removal of trace pollutants.			
Skills	The students are able to apply the relevant standards and guidelines for the design and operation urban water infrastructures independently. Their expertise comprises expert skills to design drinkin water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of the own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are able to form concepts on their own to optimize urban water infrastructure processes Therefore they can acquire appropriate knowledge when being given some clues or information with regard to the approach to problems (preparation and follow-up of the exercises).			
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German Engeneering: Compulsory General Engineering Science (German pro			



 Assignment for the Following Curricula
 Elective Compulsory

 General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

 General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory

ourse L0276: Wastewa	Iter Disposal	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>This lecture focusses on urban drainage and wastewater treatment.</li> <li>Urban Drainage <ul> <li>Design of urban drainage systems (combined and separate sewer systems)</li> <li>Special structures</li> <li>Rainwater management</li> </ul> </li> <li>Wastewater treatement <ul> <li>Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)</li> <li>Biological Treatment (aerobic, anaerobic, anoxic)</li> <li>Special Wastewater Treatment Processes (Ozonation, Adsorption)</li> </ul> </li> </ul>	
Literature	<ul> <li>Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.</li> <li>The literature listed below is available in the library of the TUHH.</li> <li>Taschenbuch der Stadtentwässerung : mit 10 Tafeln und 67 Tabellen, Imhoff, K., &amp; . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl.</li> <li>Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998.</li> <li>Kommunale Kläranlagen : Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Gunthert, F. Wolfgang: (3., vollig neu bearb. Aufl.). Renningen: expert-Verl.</li> <li>Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.</li> <li>Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>	

Course L0278: Wastewater Disposal	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0306: Drinking Water Supply		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst	
Language	DE	
Cycle	SoSe	
Content	The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer. Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g. firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems. A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters.	
Literature	Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag. Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag. DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003).	

Course L0308: Drinking	urse L0308: Drinking Water Supply	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0869: Hy	draulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L095		Lecture	2	2
Hydraulic Engineering (L096	:0)	Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Hydraulik Engineering I			
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Knowledge	explain the application of basic hydrodynamic formulations (conservation laws) to practical hydrauli engineering problems. Besides this, the students can illustrate important tasks of hydrauli engineering and give an overview over river engineering, flood protection, hydraulic powe engineering and waterways engineering. The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering systems. Besides this, they are able to use and			
Skills	apply established approaches of hydraulics and de of constructions (weirs, etc.) on channel flows as w	etermine water surfaces of	of channel fl	ows, influence
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionaly, they will be able to work in team with engineers of other disciplines.			
Autonomy	The students will be able to independently extend	their knowledge and app	ly it to new p	problems.
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Written exam			
	The duration of the examination is 2 hours. The ex understanding of the lecture contents and calculati		with respec	ct to the genera
Assignment for the Following Curricula	General Engineering Science (German prog Engeneering: Compulsory General Engineering Science (German program Elective Compulsory Civil- and Environmental Engineering: Core qualifi General Engineering Science (English program): S Compulsory General Engineering Science (English program Elective Compulsory	n, 7 semester): Specia cation: Compulsory Specialisation Civil- and	lisation Civ Enviromenta	il Engineering al Engeneering



Course L0957: Hydraulics		
Тур	Lecture	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Flow of incompressible fluids in pipes and open channels</li> <li>Hydraulics of pipes</li> <li>Punps in hydraulic systems</li> <li>Open channel flow</li> <li>Regulative construction in open channel flow <ul> <li>Weirs</li> <li>Sliding panels</li> <li>Cross-section reduction by constructions</li> </ul> </li> </ul>	
Literature	Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003 Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992	

Course L0958: Hydraulio	rse L0958: Hydraulics	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0959: Hydrauli	c Engineering
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	<ul> <li>Hydraulic power</li> <li>Inland waterways engineering <ul> <li>waterways</li> <li>Locks and ship lifts</li> <li>Fish passages</li> </ul> </li> <li>Nature-oriented hydraulic engineering</li> </ul>
Literature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011

ourse L0960: Hydraulic Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



## **Specialization Bioprocess Engineering**

Biotechnology provides the basics for sustainable manufacturing of products as food, feed, bioenergy, biopolymers and chemicals and for providing the human being wit medicines and other essential goods. It requires interdisciplinary application of natural (especially biology and chemistry) and engineering sciences. Many everyday products are manufactured by means of biotechnical production processes. Biotechnical material conversion is also used to utilize and minimize byproducts and residues in order to achieve sustainable production. Engineers with biotechnical expertise are needed to meet the growing global demand for the development and operation of biotechnical processes by which to manufacture essential everyday products.

Graduates can explain phenomena that occur in bioprocess engineering and allied disciplines. They can outline the basic bioprocess engineering principles for interpreting, modeling, and simulating biological processes and chemical reactions, energy, material, and momentum transport processes, micro-, meso- and macro-scale separation processes, and for operating the plant required for these processes. They are able to describe the basics of measurement and control technology. They can take into consideration legal aspects that arise in connection with process engineering and production facilities.

Courses				
Title		Тур	Hrs/wk	СР
Introduction into Process E Fundamentals of material e	ngineering/Bioprocess Engineering (L0829)	Lecture Lecture	2 2	1 2
		Lecture	2	۷
Module Responsible Admissior	Prof. Michael Schlüter			
Requirements	None			
Recommended Previous Knowledge	Inono			
Educational Objectives	After taking part successfully, students have	e reached the following le	earning results	
Professiona Competence				
Knowledge	<ul> <li>give an overview of the most import</li> <li>explain some working methods for one</li> </ul>			ering,
Skills	<ul> <li>After passing this module the students shot</li> <li>list and outline the most important fi</li> <li>name the most important working engineering,</li> <li>read and prepare an engineering d</li> <li>explain the most important technoloc</li> <li>scheme typical chemical and bid pointers.</li> </ul>	elds of process engineer approaches or method rawing, ogies for wastewater and	s of the different fie exhaust air treatme	nt
Personal Competence	The students are able to			
Social Competence	<ul> <li>work out results in groups and docu</li> <li>provide appropriate feedback and h</li> </ul>		own performance c	onstructively.



The students are able to estimate their progress of learning by themselves and to deliberate their lack *Autonomy* of knowledge in Process Engineering and Bioprocess Engineering.

Workload in Hours	Independent Study Time 34, Study Time in Lecture 56
Credit points	3
	Written exam
Examination duration and scale	90 min
-	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course L0829: Introduction into Process Engineering/Bioprocess Engineering				
Тур	Lecture			
Hrs/wk	2			
CP	1			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
Lecturer	Dozenten des SD V			
Language	DE			
Cycle	WiSe			
	Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.			
Literature	s. StudIP			



Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
	Dr. Marko Hoffmann		
Language	DE		
Cycle			
Content	<ul> <li>Introduction</li> <li>Atomic structure and bonding</li> <li>Structure of solids</li> <li>Miller indices</li> <li>Imperfections in solids</li> <li>Texture</li> <li>Diffusion</li> <li>Mechanical properties</li> <li>Dislocations and strengthening mechanisms</li> <li>Phase transformations</li> <li>Phase diagrams, iron-carbon phase diagram</li> <li>Metallic materials</li> <li>Corrosion</li> <li>Polymeric materials</li> <li>Ceramic materials</li> </ul>		
Literature	<ul> <li>Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012.</li> <li>Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009.</li> <li>Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008.</li> <li>Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: ein Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013.</li> <li>Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.</li> </ul>		

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Module M0730: Co	mputer Engineering				
Courses					
Title Computer Engineering (L0321) Computer Engineering (L0324)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2	
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
	Basic knowledge in electrical engineering				
Recommended Previous Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the interna structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shal understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.				
Personal Competence					
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 minutes, contents of course and labs				

	General Engineering Science (German program): Core qualification: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Energy and	
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Product Development and Production: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory	
A a a imme ant fax tha	Electrical Engineering: Core qualification: Compulsory	
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science:	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Materials in Engineering Sciences: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Energy Systems: Compulsory	
	Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory	

## Technomathematics: Specialisation II. Informatics: Elective Compulsory

TUHH

Course L0321: Compute	r Engineering	
Тур	ecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Compute	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0937: Ph	ysical Chemistry			
Courses				
Title Physical Chemistry (L0833) Physical Chemistry (L0835)		<b>Typ</b> Lecture Practical Course	Hrs/wk 2 2	<b>CP</b> 2 1
Module Responsible	Prof. Hans-Ulrich Moritz			
Admission Requirements	None			
Recommended Previous Knowledge	Contents of the previous modules inorganic ch	emistry, physics for engi	neers and math	ematics I-III.
Educational Objectives	After taking part successfully, students have rea	ached the following lear	ning results	
Professional Competence				
	The students are able,			
Kara la la	-to repeat the basic concepts of physical chemi	istry		
Knowledge	-to describe and summarize the underlying cor	ncepts of mass-, heat- a	nd momentum tr	ansfer.
	- to interpret phase diagrams and affiliate kinet	ic rate laws.		
	The students are able to			
	- conduct (fundamental) thermodynamical, elec	ctrochemical and kinetic	calculations.	
Skills	s - assess new applications with respect to environmental sustainability.			
	- abstract their knowldege to related issues to calculations.	conduct thermodynamic	cal, electrochem	nical and kine
Personal Competence				
	The students are able to plan, prepare, conc guidelines in small groups.	duct and document exp	eriments accord	ing to scienti
Social Competence	The students are able to reflect their subject-sp fellow students and faculty.	pecific knowledge orally	in a team and t	o discuss it wi
Autonomy	Students are able to assess their knowldeg Students are able to apply their knowldege dis	•	•	
Workload in Hours	Independent Study Time 34, Study Time in Lec	ture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Process Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory Process Engineering: Core qualification: Compulsory			



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions chemical equilibria, introduction into kinetics of chemical reactions, introduction into transpor phenomena, phase equilibria, equilibria at surfaces and interfaces
Literature	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>



Course L0	835: Physical Chemistry
Тур	Practical Course
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are: Reaction kinetics Freezing-point depression (cryoscopy) Electrical mobility of ions Viscosimetry Heat of neutralization Surface tension Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter http://www.chemie.uni- hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



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Courses				
Title Fundamentals of Fluid Mech		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Fluid Mechanics for Process		Recitation Section (large)		2
	Prof. Michael Schlüter			
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematics I+II+III</li> <li>Technical Mechanics I+II</li> <li>Technical Thermodynamics I+II</li> <li>Working with force balances</li> <li>Simplification and solving of partia</li> <li>Integration</li> </ul>	differential equations		
Educational Objectives	After taking part successfully, students have	re reached the following learnir	g results	
Professional Competence				
	Students are able to:			
Knowledge	<ul> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in procese engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions</li> </ul>			
	The students are able to			
Skills	<ul> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>			
Personal Competence				
	The students			
Social Competence	<ul> <li>are capable to gather information from subject related, professional publications and relate the information to the context of the lecture and</li> </ul>			
	The students are able to			
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German pr General Engineering Science (German pr General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German p	ogram): Specialisation Bioproco n program): Specialisation	ess Engineeri Energy and	ng: Compulso I Enviroment



Assignment for the Following Curricula	Energy and Environmental Engineering. Core qualification: Compulsory
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Course L0091: Fundamentals of Fluid Mechanics			
Тур	Lecture		
Hrs/wk			
СР			
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>fluid properties</li> <li>hydrostatic</li> <li>overall balances - theory of streamline</li> <li>overall balances - conservation equations</li> <li>differential balances - Navier Stokes equations</li> <li>irrotational flows - Potenzialströmungen</li> <li>flow around bodies - theory of physical similarity</li> <li>turbulent flows</li> <li>compressible flows</li> </ul>		
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011</li> </ol>		



ourse L0092: Fluid Med	chanics for Process Engineering	
Тур	Recitation Section (large)	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Michael Schlüter	
Language	DE	
Cycle	SoSe	
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.	
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011</li> </ol>	



Module M0757: Bio	ochemistry and Microbiology			
Courses				
Title Biochemistry (L0351)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Biochemistry (L0728)		Project-/problem-based	-	-
Microbiology (L0881)		Learning Lecture	2	2
Microbiology (L0888)		Project-/problem-based Learning	1	1
Module Responsible	Dr. Paul Bubenheim			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
	At the end of this module the students can:			
	- explain the methods of biological and biod biomolecules	chemical research to d	etermine the	e properties of
	- name the basic components of a living organism	1		
Knowledge	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Skills Personal Competence				
	The students are able,			
	- to gather knowledge in groups of about 10 stude	ents		
Social Competence	- to introduce their own knowledge and to argue t	heir view in discussions i	n teams	
	- to divide a complex task into subtasks, solve the			ts
Autonomy	The students are able to present the results of the			
Credit points	Independent Study Time 96, Study Time in Lecture 84			
Examination				
Examination duration and scale				
-	General Engineering Science (German program) General Engineering Science (German program, Compulsory Bioprocess Engineering: Core qualification: Com General Engineering Science (English program): General Engineering Science (English program, Compulsory Technomathematics: Specialisation III. Engineerin	7 semester): Specialisati pulsory Specialisation Bioproces 7 semester): Specialisati	on Bioproce s Engineerir on Bioproce	ss Engineering: ng: Compulsory



ourse L0351: Biochemistry		
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Paul Bubenheim	
Language	DE	
Cycle	SoSe	
Content	<ol> <li>Metabolism:         <ol> <li>Basic principles</li> <li>Photosynthesis</li> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Respiration</li> <li>Anaerobic respirations</li> <li>Fatty acid metabolism</li> <li>Amino acid metabolism</li> </ol> </li> </ol>	
Literature	Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin	



ourse L0728: Biochemistry			
Тур	Typ Project-/problem-based Learning		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Paul Bubenheim		
Language	DE		
Cycle	SoSe		
Content	<ol> <li>The molecular logic of Life</li> <li>Biomolecules:         <ol> <li>Amino acids, peptides, proteins</li> <li>Carbohydrates</li> <li>Lipids</li> </ol> </li> <li>Protein functions, Enzymes:         <ol> <li>Michaelis-Menten kinetics</li> <li>Enzyme regulation</li> <li>Enzyme nomenclature</li> </ol> </li> <li>Cofactors and cosubstrates, vitamines</li> <li>Metabolism:         <ol> <li>Basic principles</li> <li>Photosynthesis</li> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Respiration</li> <li>Anaerobic respirations</li> <li>Fatty acid metabolism</li> <li>Amino acid metabolism</li> </ol> </li> </ol>		
Literature	Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin		



Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	<ul> <li>1. The procaryotic cell <ul> <li>evolution</li> <li>taxonomy and specific properties of Archaea, Bacteria, and viruses</li> <li>structure and properties of the cell</li> <li>growth</li> </ul> </li> <li>2. Metabolism <ul> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> </ul> </li> <li>3. Microorganisms in relation to the environment <ul> <li>chemotaxis and motility</li> <li>Elemental cycle of carbon, nitrogen and sulfur</li> <li>biofilms</li> <li>symbiotic relationships</li> <li>extremophiles</li> <li>biotechnology</li> </ul> </li> </ul>
Literature	<ul> <li>Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)</li> <li>Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehem "Brock", Pearson Verlag (89,95 €)</li> <li>Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag</li> <li>Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 http://www.grundlagen-der-mikrobiologie.icbm.de/</li> </ul>



Тур	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	<ol> <li>The procaryotic cell         <ul> <li>evolution</li> <li>taxonomy and specific properties of Archaea, Bacteria, and viruses</li> <li>structure and properties of the cell</li> <li>growth</li> </ul> </li> <li>Metabolism         <ul> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> </ul> </li> <li>Microorganisms in relation to the environment         <ul> <li>chemotaxis and motility</li> <li>Elemental cycle of carbon, nitrogen and sulfur</li> <li>biofilms</li> <li>symbiotic relationships</li> <li>extremophiles</li> <li>biotechnology</li> </ul> </li> </ol>
Literature	<ul> <li>Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)</li> <li>Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehem "Brock", Pearson Verlag (89,95 €)</li> <li>Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag</li> <li>Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 http://www.grundlagen-der-mikrobiologie.icbm.de/</li> </ul>



Courses				
<b>Title</b> Phase Equilibria Thermodyr Phase Equilibria Thermodyr		<b>Typ</b> Lecture Recitation Section (sma	<b>Hrs/wk</b> 2 I) 1	<b>CP</b> 2 2
Phase Equilibria Thermodyn	amics (L0142)	Recitation Section (large	) 1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Therm	odynamics I and II		
Educational Objectives	After taking part successfully, students ha	ave reached the following learni	ng results	
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of the describe thermodynamic equilibrities and the quantitatively describe these present to quantitatively describe the present to quantitatively describe t</li></ul>	a. re influenced by the mixing of co roperties. r phase equilibria can be descril rrent phases (vapor, liquid, s reaction equilibria are taught. everal examples relevant for dif	ompounds and bed mathemat colid) coexist ferent kinds o	d learn concep ically and whi in equilibriu f processes a
Skills	<ul> <li>Applying their knowledge, the determination of the equilibrium s</li> <li>The students know models which equilibrium state and they are abl</li> <li>For specific applications, they properties of compounds as well</li> <li>Beside pure compound propertimixtures.</li> <li>The students know how to visu interpret the occurring phenomen</li> <li>Based on their knowledge, the st the basis for many separation and</li> </ul>	tate and know how to simplify the can be used to determine the le to solve the resulting mathem are able to self-reliantly find as model parameters in literatur es the students are capable of ualize phase equilibria graphi- ta. udents are able to understand f	ese equations properties of the atical relations necessary p e sources. f describing the cally and the undamental c	s meaningfully he system in t s. hysico-chemic he properties y know how oncepts that a
Personal Competence	The students are able to work in small	arouns to solve the correspon	dina problems	and to prese
Social Competence	them oraly to the tutors and other student			
Autonomy	<ul> <li>The students are able to find ne judge their quality.</li> <li>During the semester the student exercises. Based on this knowled</li> </ul>	ts are able to check their learr	ing progress	continuously
Workload in Hours				



Credit.points Examination	∯ritten exam
Examination duration and scale	120 minutes; theoretical questions and calculations
•	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Process Engineering: Core qualification: Compulsory

Course L0114: Phase Equilibria Thermodynamics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	SoSe	
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: eaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>	
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>	



urse L0140: Phase Equilibria Thermodynamics			
Тур	Typ Recitation Section (small)		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language			
Cycle	SoSe		
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemica potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: equilibrium condition, binary systems</li> <li>Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>		
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluic Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. 0 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>		



Course L0142: Phase Equilibria Thermodynamics		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	SoSe	
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>	
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid- Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>	



	gnals and Systems			
Courses				
<b>Title</b> Signals and Systems (L043: Signals and Systems (L043:		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible		( 0 )		
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of s covered by the moduls Mathematik 1-3 is expect (Fourier series, Fourier transform, Laplace transfo	ted. Further experience w	ith spectral t	
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin 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 determinist			
Skills	signal to a discrete-time signal. The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
	The students can jointly solve specific problems. The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points				
-	Written exam			
Examination duration and scale				
	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German program): General Engineering Science (German program):	Specialisation Computer Specialisation Process E Specialisation Bioproces ogram): Specialisation ogram): Specialisation	Science: Co ngineering: s Engineerir Civil- and Mechanical al Engineerir	empulsory Compulsory ng: Compulso Enviroment Engineerin ng: Compulso



	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	deneral Engineering Science (English program). Specialisation Chin- and Environmental Engeneering.
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



se L0432: Signals and Systems			
Тур			
Hrs/wk			
СР			
	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Gerhard Bauch		
	SoSe		
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>		
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



ourse L0433: Signals and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
<b>Title</b> Bioprocess Engineering - Fu Bioprocess Engineering- Fu		<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 3 1 2
Module Responsible	, , ,			
Admission Requirements				
Recommended Previous Knowledge	none, module "organic chemistry", module	"fundamentals for process eng	ineering"	
Educational Objectives	After taking part successfully, students have	e reached the following learnin	g results	
Professional Competence Knowledge	Students are able to describe the basic co different types of kinetics for enzymes and inhibition. The parameters of stoichiometry	microorganisms, as well as to and rheology can be named a	differentiate o nd mass tran	different types sport processe
Skills	biolecimical problem	downstream processing in deta students should be able to hes for growth and substrate f energy generation, regenera n process toichiometry and to set up / sol ria for different bioreactors a to compare them as well a	ail. uptake and tion of redox ve metabolic nd bioproces as to apply t	to calculate th equivalents ar flux equations ses (anaerobi hem to curre
	<ul> <li>propose solutions to complicated b models</li> <li>to explore new knowledge resource</li> <li>identify scientific problems with con</li> <li>to document and discuss their proce</li> </ul>	es and to apply the newly gaine crete industrial use and to form	ed contents julate solutior	IS.
Personal Competence Social Competence	After completion of this module participar teams to enhance the ability to take pos teamwork in engineering and scientific env	tion to their own opinions an		
Autonomy	After completion of this module participa independently by organizing their workflow			olem in a tea
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Examination				
Examination duration and scale				
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German p Compulsory	gram): Specialisation Bioproc	ess Engineeri	ng: Compulso



	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
-	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective
	Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective
	Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0841: Bioprocess Engineering - Fundamentals		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture</li> <li>Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese)</li> <li>Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese)</li> <li>Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)</li> <li>Kinetic of subtrate consumption and product formation (Prof. Zeng)</li> <li>Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)</li> <li>Transport process in a bioreactor (Prof. Zeng)</li> <li>Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)</li> <li>Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)</li> </ul>	
Literature	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> </ul>	



Tue	
	Recitation Section (large)
Hrs/wk	
СР	
	Independent Study Time 2, Study Time in Lecture 28
	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	
Cycle	SoSe
Content	<ol> <li>Enzymatic kinetics (Prof. Liese)</li> <li>Stoichiometry I + II (Prof. Liese)</li> <li>Microbial Kinetics I+II (Prof. Zeng)</li> <li>Rheology (Prof. Liese)</li> <li>Mass transfer in bioprocess (Prof. Zeng)</li> <li>Continuous culture (Chemostat) (Prof. Zeng)</li> <li>Sterilisation (Prof. Zeng)</li> <li>Downstream processing (Prof. Liese)</li> <li>Repetition (Reserve) (Prof. Liese, Prof. Zeng)</li> </ol>
Literature	siehe Vorlesung

Course L0843: Bioproce	ess Engineering - Fundamental Practical Course
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out. The students document their experiments and results in a protocol.
Literature	Skript



	at and Mass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (LC Heat and Mass Transfer (LC		Lecture Recitation Section (small)	2 1	2 2
Heat and Mass Transfer (L	,	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynam	lics		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of explain procedural apparatus (e. g. heat exc</li> <li>They are capable of distinguish an namely heat conduction, heat transf</li> <li>The students have the ability to except describe mass transfer qualitative a</li> <li>They are able to depict the analogy linked processes in detail.</li> </ul>	changer, chemical reactors). Id characterize different kinds o fer and thermal radiation. xplain the physical basis for ma nd quantitative by using suitable	f heat transf ss transfer mass trans	fer mechanisn in detail and fer theories.
Skills	<ul> <li>The students are able to set reaso using the gained knowledge and respectively.</li> <li>They are capable to solve specifit temperature alteration in fluids) and</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish betwee They can use this knowledge for column, rectification column).</li> <li>In this context, the students are cap mass exchanger for a specific apparatus.</li> <li>The students are capable to conne of other courses (In particular the process engineering) to solve concrete.</li> </ul>	I to balance the correspondin c heat transfer problems (e.g. to calculate the corresponding l e students can execute scaling u en diffusion, convective mass tr the description and design of pable to choose and design fun- plication considering their adva steady-state and non-steady-state ect their knowledge obtained in t courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flow emical reactor cal processes d mass transfe (e.g. extraction pes of heat an disadvantage es in procedur with knowlego
Personal Competence Social Competence	<ul> <li>The students are capable to work or results or ally in a reasonable manner.</li> </ul>		n teams and	d to present th
	<ul> <li>The students are able to find and ev</li> <li>They are able to prove their lev procedure continuously (clicker-system)</li> </ul>	el of knowledge during the c	course with	accompanyir



Autonomy	control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory



Course L0101: Heat and Mass Transfer	
Typ Lecture	
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	<ol> <li>Heat transfer         <ul> <li>Introduction, one-dimensional heat conduction</li> <li>Convective heat transfer</li> <li>Multidimensional heat conduction</li> <li>Non-steady heat conduction</li> <li>Thermal radiation</li> </ul> </li> <li>Mass transfer         <ul> <li>one-way diffusion, equimolar countercurrent diffusion</li> <li>boundary layer theory, non-steady mass transfer</li> <li>Heat and mass transfer single particle/ fixed bed</li> <li>Mass transfer and chemical reactions</li> </ul> </li> </ol>
Literature	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>

Course L0102: Heat and Mass Transfer	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title Thermal Separation Process Thermal Separation Process Thermal Separation Process Separation Processes (L115	ses (L0119) ses (L0141)	<b>Typ</b> Lecture Recitation Section (small) Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 2 1 1	<b>CP</b> 2 1
Module Responsible				
A dmission				
Recommended Previous Knowledge	Recommended requirements: Thermodyna	mics III		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can distinguish and distillation, extraction, and adsorptio</li> <li>The students develop an understa process, the estimation of the energy and the selection of separation syste</li> <li>They have good knowledge of designed</li> </ul>	n nding for the course of concen gy demand of a process, the po ems	tration durir ssibilities of	ng a separatio energy savin
Skills	<ul> <li>Using the gained knowledge the stuse separation process and can close the The students can use different graand define the amount of theoretica</li> <li>They can select and design a basic on the advantages and disadvantage</li> <li>The students are capable to obt appropriate sources (diagrams and</li> <li>They can calculate continuous and</li> <li>The students are able to prove their</li> <li>The students are able to discuse experimental work with the teachers</li> </ul>	te associated energy and materi phical methods for the designin stages required type of thermal separation proc les of the process ain independently the needed tables) discontinuous processes theoretical knowledge in the exp s the theoretical background in colloquium.	al balances ng of a sep ess for a giv d material berimental l and the nt of other le	aration proce ven case base properties fro ab work. content of th ectures and u
Personal Competence	The students can work technical	assignments in small groups a	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out p division of labor between them. Th scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to ob themselves and assess their quality</li> <li>The students can proof the state of this way control their learning proce</li> </ul>	their knowledge with exam rese		



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	
	Written exam
Examination duration and scale	120 minutes' theoretical dijestions and calculations
Assignment for the Following Curricula	Energy and Environmental Engineering. (Core gualification: Compulsory



ourse L0118: Thermal	Separation Processes
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg., 6th ed., McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technische Chemie</li> </ul>



	Separation Processes
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry''s Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th endocymentalies in the separation chemie</li> </ul>



Course L0141: Thermal Separation Processes		
Тур	Typ Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>	
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>	



Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
	Compulsory attendence of the colloquia of all experiments and compulsory report.	
	Prof. Irina Smirnova	
Language		
Cycle		
Content	<ul> <li>The students work on eight different experiments in this practical course. For every one of the eigh experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.</li> <li>The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback or their own reports and level of scientific writing so they can increase their capabilities in this area.</li> <li>Topics of the practical course: <ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul> </li> </ul>	
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technischen Chemie</li> </ul>	



Module M0892: Ch	emical Reaction Engineering			
Courses				
Title         Chemical Reaction Engineering (Fundamentals) (L0204)         Chemical Reaction Engineering (Fundamentals) (L0244)         Experimental Course Chemical Engineering (Fundamentals) (L0221)		<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	None			
	Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+I as well as computational methods for engineers.			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties.		s have a strong	
	After successful completion of the module, stud		a tha a was a lid	a al va a ata va
Skills	<ul> <li>apply different computational methods to dime</li> <li>determine and compute stable operation poin</li> </ul>		souriermario	earreactors,
	- conduct experiments on a lab-scale pilot guidelines.		ese accordi	ng to scientific
Personal Competence				
Social Competence	After successful completition of the lab-cou themselfes in small groups to solve issues in ch their subject related knowledge among each ot	nemical reaction engineering her and with their teachers.	g. The stude	ents can discuss
Autonomy	The students are able to obtain further informat can apply their knowldege discretely to plan, pr			ously. Students
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
-	General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory Bioprocess Engineering: Core qualification: Co General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory Process Engineering: Core qualification: Comp	n): Specialisation Bioproces am, 7 semester): Specialisation m, 7 semester): Specialisation mpulsory n): Specialisation Bioprocess n): Specialisation Process Ei am, 7 semester): Specialisation n, 7 semester): Specialisation	es Engineeri ation Proces on Bioproce s Engineerin ngineering: ation Proces	ng: Compulsory ss Engineering ss Engineering ng: Compulsory Compulsory ss Engineering

Course L0204: Chemical Reaction Engineering (Fundamentals)	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28



Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Content	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH



	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
Literature	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course L0244: Chemical Reaction Engineering (Fundamentals)	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE
Cycle	WiSe
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic



Content	measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
Literature	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



Course L0221: Experimental Course Chemical Engineering (Fundamentals)			
Тур	Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch		
Language	DE/EN		
Cycle	SoSe		
Content	Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors: * Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate *CSTR - Residence time distribution, reaction *CSTR in Series - Residence time distribution, reaction * Plug Flow Reactor - Residence time distribution, reaction Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.		
Literature	Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB) Praktikumsskript Skript Chemische Verfahrenstechnik 1 (F.Keil)		



Module M0945: Bid	oprocess Engineering - Advanced			
Courses				
<b>Title</b> Bioprocess Engineering - Advanced (L1107) Bioprocess Engineering - Advanced (L1108)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible	Prof. An-Ping Zeng			
Admission Requirements	None			
Recommended Previous Knowledge	Content of module "Biochemical Engineering I"			
Educational Objectives Professional Competence			results	
Knowledge	<ul> <li>After successful completion of this module, studer</li> <li>describe and explain different kinetic appr</li> <li>identification of scientific problems with c and mammalian cells)</li> </ul>	oaches for growth and sul		
Kilowieuge	<ul> <li>describe and explain important downstreast basic immobilization methods</li> </ul>	aming steps for proteins a	nd their app	lication as wel
Skills	<ul> <li>After successful completion of this module, studer</li> <li>to identify scientific questions or possible pract cultivation of microorganisms and animal cells ) a</li> <li>To assess the application of scale-up criteria fo apply these criteria to given problems (anaerobic</li> <li>to formulate questions for the analysis and processes appropriate solutions ,</li> <li>To describe the effects of the energy generation growth inhibition of the behavior of microorganism</li> <li>Establish material flow balance equations and different approaches and to calculate immobilizat</li> <li>to select process control strategies (batch , fed basic types and evaluate them.</li> </ul>	ical problems for concrete nd to formulate solutions , r different types of bioreau , aerobic or microaerobica d optimization of real bi n, the regeneration of redu ns and to the total fermenta I solve them to determine ion and activity yields ,	ctors and pro ally) iotechnologic uction equiva ation process e the kinetic	cesses and to cal production lents , and the s qualitatively parameters o
Personal Competence	After completion of this module participants should be able to debate technical questions in teams to enhance the ability to take position to their own opinions and increase their capa			
Social Competence Autonomy	teamwork. After completion of this module participants are a their knowledge to previously unknown issues an	-	es of knowle	dge and apply
		-		
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lectu	Ire 56		
	o Written exam			
=Authination				



Examination duration and scale	90 min
Assignment for the Following Curricula	(General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory I

Course L1107: Bioprocess Engineering - Advanced		
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese, Dr. Wael Sabra	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture</li> <li>Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)</li> <li>Enzymatic process II (Prof. Liese)</li> <li>Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)</li> <li>Anaerobic fermentation processes (Prof. Zeng)</li> <li>Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)</li> <li>Fedbatch process and cultivation with high cell density (Prof. Zeng)</li> <li>Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)</li> <li>Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)</li> <li>Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)</li> </ul>	
Literature	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> <li>Skripte für die Vorlesung</li> </ul>	



Course L1108: Bioproce	ess Engineering - Advanced		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture</li> <li>Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)</li> <li>Enzymatic process II (Prof. Liese)</li> <li>Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)</li> <li>Anaerobic fermentation processes (Prof. Zeng)</li> <li>Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)</li> <li>Fedbatch process and cultivation with high cell density (Prof. Zeng)</li> <li>Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)</li> <li>Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)</li> <li>Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)</li> </ul>		
Literature	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> <li>Skripte für die Vorlesung</li> </ul>		



Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (L1387) Environmental Technologie (L0326)		Practical Course Lecture	1 2	1 2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chem	istry and biology		
Educational Objectives	After taking part successfully, students ha	ve reached the following learn	ing results	
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound knowledge of environmenta technology. They are able to describe the behaviour of chemicals in the environment. Students can give an overview of scientific disciplines involved. They can explain terms and allocate them to related methods.			
Skills	Students are able to propose appropriate management and mitigation measures for environmenta problems. They are able to determine geochemical parameters and to assess the potential o pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and			
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge an tranfer it to new problems.			
Workload in Hours	Independent Study Time 48, Study Time	n Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour			
Assignment for the Following Curricula				

### Process Engineering: Core qualification: Elective Compulsory

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Course L1387: Practical Exercise Environmental Technology		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Joachim Gerth	
Language	DE	
Cycle	SoSe	
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515	

Course L0326: Environmental Technologie			
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta		
Language	DE		
Cycle	WiSe		
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>		
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)		

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Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible				_
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models or vice versa</li> <li>They can simulate and assess the They can design PID controllers with They can analyze and synthes frequency response techniques</li> <li>They can calculate discrete-time and use it for digital implementation</li> <li>They can use standard software to tasks</li> </ul>	behavior of systems and control vith the help of heuristic (Ziegler-N ize simple control loops with th approximations of controllers do on	oops ichols) tunir ne help of esigned in o	ig rules root locus ar continuous-tim
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate			
Autonomy	their controller designs Students can obtain information from experiment guides) and use it when solvi They can assess their knowledge in weel	ng given problems.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory	

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	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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 Root locus techniques Root locus plots Not locus plots Steparate error, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Frequency response interpretation of PID control Sustems Root locus and frequency response of time delay systems Simith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses				
Title Process and Plant Engineering I (L0095) Process and Plant Engineering I (L0096) Process and Plant Engineering I (L1214)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	unit operation of thermal an dmechanical s chemical reactor eingineering	separation processes		
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence				
Knowledge	students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilliation problems			
Skills	explain pfd-diagrams students are capable of - formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and the estimation of production costs			
Personal Competence				
Social Competence				
Autonomy	Independent Study Time 124, Study Time	in Lastura 56		
Credit points				
	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy a Enviromental Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (English program): Specialisation Process Engineering: Compulsor General Engineering Science (English program): Specialisation Process Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory			



General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory

ourse L0095: Process	and Plant Engineering I	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work		
	Prof. Georg Fieg	
Language		
Content	SoSe         1. Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants         2. Engineering methods and tools         Mass and energy balances         Strategies of process synthesis         Graphical representation of processes         Multidimensional regression         Data reconciliation and data validation         3. Process Synthesis         Decision levels         Experimental process development         Reactor synthesis         Synthesis of separation processes (process alternatives and criteria for selection)         Integration of reaction systems/separation systems (interactions, recycle streams)         4. Process safety         5. Cost estimation of production plants         Production costs, capital costs, economic evaluation	
	<ul> <li>S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679</li> <li>H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74</li> <li>Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157</li> <li>E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997</li> <li>M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916</li> <li>R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&amp;Co.KGaA, Weinheim, 2004</li> <li>J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988</li> <li>G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19</li> <li>G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306</li> <li>G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213</li> <li>G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133</li> <li>U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlun Blazek und Bergamann, Frankfurt, 2000</li> </ul>	

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Literature	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
	G. Kaibel, Dissertation, TU München, 1987
	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process and Plant Engineering I			
Тур	Typ Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Course work	none		
Lecturer	Prof. Georg Fieg		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1214: Process	ourse L1214: Process and Plant Engineering I		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Course work	none		
Lecturer	Prof. Georg Fieg		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
<b>Title</b> Particle Technology I (L0434 Particle Technology I (L0435		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 3 1
Particle Technology I (L0440		Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous Knowledge	keine			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>name and explain processes and unit-operations of solids process engineering,</li> <li>characterize particles, particle distributions and to discuss their bulk properties</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>choose and design apparatuses and processes for solids processing according to the desire solids properties of the product</li> <li>asses solids with respect to their behavior in solids processing steps</li> <li>document their work scientifically.</li> </ul>			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with other students or scientific personal and to develop solutions for technical-scientific issues in a group.			
Autonomy	Students are able to analyze and solve que		ndependen	tly.
Credit points	Independent Study Time 110, Study Time in			
Examination				
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (German program): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory			



### Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course L0434: Particle	Fechnology I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology I		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Stefan Heinrich	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0440: Particle 1	Fechnology I
	Practical Course
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Stefan Heinrich
Language	
Cycle	
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Module M0829: Foundations of Management					
Courses					
Title		Тур	Hrs/wk	СР	
Introduction to Management	(L0880)	Lecture	3	3	
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3	
Module Responsible	Prof. Christoph Ihl	-			
Admission Requirements	None				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>				
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under rise</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>				
Personal Competence					
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere</li> </ul>				
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>				
Workload in Hours	Independent Study Time 110, Study Time ir	n Lecture 70			
Credit points	6				
Examination	Subject theoretical and practical work				
Examination duration	several written exams during the semester				



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Accience and family	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Assignment for the Following Curricula	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture
l	

Compulsory	
General Engineering Science (English	program, 7 semester): Specialisation Computer Science:
Compulsory	
General Engineering Science (English p Compulsory	rogram, 7 semester): Specialisation Bioprocess Engineering:
General Engineering Science (English	n program, 7 semester): Specialisation Civil Engineering:
Compulsory	rearrow 7 competers): Providiantian Energy and Environmental
Engineering: Compulsory	rogram, 7 semester): Specialisation Energy and Enviromental
General Engineering Science (English p Focus Mechatronics: Compulsory	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
General Engineering Science (English p Focus Aircraft Systems Engineering: Con	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
•	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
Computational Science and Engineering	: Core qualification: Compulsory
Computational Science and Engineering	
Logistics and Mobility: Core qualification	
Mechanical Engineering: Core qualificati	
Mechatronics: Core qualification: Compu	
Naval Architecture: Core qualification: Co	•
Technomathematics: Core qualification:	
Process Engineering: Core qualification:	Compulsory



Typ	Lecture		
Hrs/wk			
CP			
	 Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



	Hrs/wk	СР
e	2	2
tion Section (small)	) 1	1
у		
following loornin		
following learnin	ig results	
With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects or construction measures. They have knowledge about the methodological diversity and are competent in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertainties and difficulties with their measurement.		
The students are able to select a suitable method for the respective case from the variety or assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.		
The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity and consciousness towards these subjects are raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.		
The students learn to research, process and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business contex and are able to judge results of other publications.		
Specialisation pecialisation Pro 7 semester): S mester): Specialis ester): Specialisat	ocess Engin Specialisatio isation Proce	eering: Electi n Energy a ess Engineerir
npuls on: C	ory ompulsory	ory ompulsory

#### TUHH Hamburg University of Technolog

Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Process Engineering: Elective	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:	
	Elective Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	
	Elective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory	
	Process Engineering: Core qualification: Compulsory	

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
Content	Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment , SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	



Course L1054: Environn	nental Assessment
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject- specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.
Literature	Power point Präsentationen



## **Specialization Electrical Engineering**

The educational objective of the General Engineering Science BSc program's electrical engineering specialization is to develop the ability to choose and combine fundamental methods and processes in order to solve technical tasks in engineering science and, especially, the specialization subject.

Graduates will have

1) A firm grounding in mathematics, physics, electrical engineering, and computer science

2) A basic knowledge of systems theory, control systems, and electrical power and energy or measurement technology

3) In-depth knowledge of engineering science areas, especially their specialization area (electrical engineering materials and components, semiconductor technology, communications engineering, electromagnetig theory). They will, in particular, have the methodological skills required for applying their knowledge to the solution of technical problems, taking technical, economic and societal requirements into account.

Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (sm	all) 2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathemat	ics I and II		
Educational Objectives	After taking part successfully, students ha	ave reached the following learr	ning results	
Professional Competence				
Knowledge	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 transien 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.			
Skills	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				
Social Competence	Students work on exercise tasks in small guided groups. They are encouraged to present and discu their results within the group.			
Autonomy	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 w knowledge to other courses like Electrical Engineering I and Mathematics I.			



Worklead in Hours Credit points	Independent Study Time 110, Study Time in Lecture 70	
Examination		
Examination duration and scale	150 min	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory 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 General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	WiSe
	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
Content	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
	- 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)
Literature	<ul> <li>- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)</li> <li>- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)</li> </ul>
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)



Course L0567: Circuit Theory		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle	WiSe	
Content	see interlocking course	
	siehe korrespondierende Lehrveranstaltung	
Literature	see interlocking course	



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	<ul> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are liftec	examination
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. <i>alls</i> After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate t	his knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science:
<b>J</b>	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory

### Technomathematics: Specialisation II. Informatics: Elective Compulsory

TUHH

Course L0321: Compute	er Engineering	
Тур	ecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Compute	ourse L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I: Time-Independent Fields (L0180) Theoretical Electrical Engineering I: Time-Independent Fields (L0181)		Lecture Recitation Section (small)	3 2	5 1
	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous Knowledge	Basic principles of electrical engineering an	d advanced mathematics		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students can explain the fundamental formulas, relations, and methods of the theory of time- independent electromagnetic fields. They can explicate the principal behavior of electrostatic magnetostatic, and current density fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-independent electromagnetic fields and are able to explicate these.			
Skills	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time independent, electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell's Equations for more general problems. The students ca assess the principal effects of given time-independent sources of fields and analyze thes quantitatively. They can deduce meaningful quantities for the characterization of electrostatic magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given field and dimension them for practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subj their results effectively (e.g. during exercise		s. They are	able to preser
Autonomy	Students are capable to gather necessary information from provided references and relate thi information to the lecture. They are able to continually reflect their knowledge by means of activitie that accompany the lecture, such as short oral quizzes during the lectures and exercises that ar 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).			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following Curricula				



Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

	cal Electrical Engineering I: Time-Independent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	
Cycle	
Content	<ul> <li>Maxwell's Equations in integral and differential notation</li> <li>Boundary conditions</li> <li>Laws of conservation for energy and charge</li> <li>Classification of electromagnetic field properties</li> <li>Integral characteristics of time-independent fields (R, L, C)</li> <li>Generic approaches to solving Poisson's Equation</li> <li>Electrostatic fields and specific methods of solving</li> <li>Magnetostatic fields and specific methods of solving</li> <li>Fields of electrical current density and specific methods of solving</li> <li>Action of force within time-independent fields</li> <li>Numerical methods for solving time-independent problems</li> </ul>
Literature	<ul> <li>G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)</li> <li>H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)</li> <li>W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)</li> <li>D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)</li> <li>J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)</li> <li>Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)</li> </ul>



Тур	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Schuster
Language	DE
Cycle	SoSe
	<ul> <li>Maxwell's Equations in integral and differential notation</li> <li>Boundary conditions</li> <li>Laws of conservation for energy and charge</li> </ul>
	<ul> <li>Classification of electromagnetic field properties</li> <li>Integral characteristics of time-independent fields (R, L, C)</li> </ul>
Content	- Generic approaches to solving Poisson's Equation
Coment	<ul> <li>Electrostatic fields and specific methods of solving</li> <li>Magnetostatic fields and specific methods of solving</li> </ul>
	- Fields of electrical current density and specific methods of solving
	<ul> <li>Action of force within time-independent fields</li> <li>Numerical methods for solving time-independent problems</li> </ul>
Literature	<ul> <li>G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)</li> <li>H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)</li> <li>W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)</li> </ul>
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013) - Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M0748: Ma	iterials in Electrical Engineering			
Courses				
Title Electrotechnical Experiment Materials in Electrical Engine Materials in Electrical Engine		<b>Typ</b> Lecture Lecture Recitation Section (small)	Hrs/wk 1 2 2	<b>CP</b> 1 3 2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Highschool level physics and mathematics			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the composition and the structural properties of materials used in electrical engineering. Students can explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of their applications in electrical engineering.			
Skills	Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solutions and judge factors influential on the performance of materials in electrical engineering applications.			
Personal Competence Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.			
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
	Written exam			
Examination duration and scale	160 minutes			
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory			



Тур	Lecture	
Hrs/wk	1	
CP		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Wieland Hingst	
Language		
Cycle		
	Agenda:	
	- Natural sources of electricity	
	- Oscilloscope	
	- Characterizing signals	
	- 2 terminal circuit elements	
	- 2-ports	
	- Power	
	- Matching	
Content	- Inductive coupling	
	- Resonance	
	- Radio frequencies	
	- Transistor circuits	
	- Electrical measurement	
	- Materials for the EE	
	- Electrical fun	
	Tietze, Schenk: "Halbleiterschaltungstechnik", Springer	
Literature		



Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	SoSe
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition. Symmetries, conserved quantities, and the labeling of states. Angular momentum The hydrogen atom Waves in periodic potentials Reciprocal lattice and reciprocal lattice vectors Band gap Band diagrams The free electron gas and the density of states Fermi-Dirac distribution Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping. The P-N junction (diode) Light emitting diodes Electromagnetic waves interacting with materials Reflection and refraction Photonic band gaps Origins of magnetization Hysteresis in ferromagnetic materials Magnetic domains
Literature	<ol> <li>Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials, Massachusetts Institute of Technology (MIT), 2013</li> <li>Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004</li> <li>Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994</li> <li>Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994</li> <li>Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979</li> <li>Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004</li> <li>Ashcroft, Mermin, Solid State Physics, Harcourt, 1976</li> <li>Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988</li> <li>Sze, Physics of Semiconductor Devices, Wiley, 1981</li> <li>Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007</li> <li>Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 200</li> <li>Handley, Modern Magnetic Materials, Wiley, 2000</li> <li>Wikipedia, Wikimedia</li> </ol>



Тур	Recitation Section (small)
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	SoSe
Content	<ul> <li>Atom structure and periodic system</li> <li>Atom binding and crystal structure</li> <li>Structure and properties of alloys: diffusion, phase diagrams, phase separation and grain boundaries</li> <li>Material properties: Mechanical, thermal, electrical, dielectric properties</li> <li>Metals</li> <li>Semiconductors</li> <li>Ceramics and glasses</li> <li>Polymers</li> <li>Magnetic materials</li> <li>Electrochemistry Oxidation numbers, electrolysis, batteries, fuel cells</li> </ul>
Literature	H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993)

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Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (large)	3 1	4 2
	* 		•	-
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
Recommended	The modul is an introduction to the the	ory of signals and systems. Go	od knowled	ge in maths a
	covered by the moduls Mathematik 1-3 is	expected. Further experience w	ith spectral	
	(Fourier series, Fourier transform, Laplace	transform) is useful but not requi	red.	
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional				
Competence	<b></b>			
	The students are able to classify and demethods of signal and system theory. T			
Knowledge	continuous-time and discrete-time signals	and systems. They can describe	e and analy	se determinis
Knowledge	signals and systems mathematically in bo		-	
	effects in time domain and image domai signal to a discrete-time signal.	in which are caused by the tran	Shion of a c	continuous-tir
	The students are able to describe and an	alyse deterministic signals and li	near time-in	variant syster
	using methods of signal and system theo			
	important properties such as magnitude a the impact of LTI systems on the signal pro			hey can asse
Personal Competence		······································		
Social Competence	The students can jointly solve specific prol	olems.		
	The students are able to acquire relevant information from appropriate literature sources. They ca			
Autonomy	control their level of knowledge during the clicker system.	e lecture period by solving tutori	al problems	, software too
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Examination				
Examination duration	90 min			
and scale				
	General Engineering Science (German pr General Engineering Science (German pr			
	General Engineering Science (German pr			
	General Engineering Science (German pr			
	General Engineering Science (Germ Engeneering: Compulsory	an program): Specialisation	Civil- and	Enviroment
	General Engineering Science (Germ	an program): Specialisation	Mechanica	I Engineerin
	Compulsory			- ·
	General Engineering Science (German pr General Engineering Science (German p		-	
	Compulsory			-
	General Engineering Science (German	program, 7 semester): Special	sation Com	nputer Scienc
	Compulsory General Engineering Science (German p	program, 7 semester): Specialisa	ation Proces	s Engineerin
	Compulsory			-
	General Engineering Science (German pr	ogram, 7 semester): Specialisatio	on Bioproce	ss Engineerin
	Compulsory General Engineering Science (German pr	ogram, 7 semester): Specialisatio	on Biomedic	al Engineerin
	Compulsory			-
	General Engineering Science (German pr Focus Biomechanics: Compulsory	ogram, 7 semester): Specialisatio	on Mechanic	al Engineerin



	Consul Engineering Colones (Correspondence 7 consister), Consisting Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
5	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory Constal Engineering Science (English program, 7 competer); Specialization Process Engineering;
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



ourse L0432: Signals and Systems			
Тур	Typ Lecture		
Hrs/wk	3		
СР			
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Gerhard Bauch		
Language			
Cycle	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>		
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



ourse L0433: Signals and Systems	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0709: Ele	ectrical Engineering IV: Transmission	n Lines and Resea	rch Semi	inar
Courses				
<b>Title</b> Research Seminar Electrica Transmission Line Theory (I Transmission Line Theory (I	,	<b>Typ</b> Seminar Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 3 1
Module Responsible	Prof. Arne Jacob			
Admission Requirements				
Recommended Previous Knowledge	Electrical Engineering I-III, Mathematics I-III			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the fundamentals of wave frequencies. They are able to analyze circuits wit They can describe simple equivalent circuits of t with coupled transmission lines. They can present	th transmission lines in til ransmission lines. They a	me and freq are able to s	uency domain solve problems
	Students can analyze and calculate the propagation of waves in simple circuits with transmissio lines. They are able to analyze circuits in frequency domain and with the Smith chart. They ca analyze equivalent circuits of transmission lines. They are able to solve problems including couple transmission lines using the vectorial transmission line equations. They are able to give a talk t professionals.			
Personal Competence Social Competence	Students can analyze and solve problems in small groups and discuss their solutions. They ca compare the learned theory with experiments in the lecture and discuss it in small groups. They are the learned theory with experiments in the lecture and discuss it in small groups.			
Autonomy	The students can solve problems by their own and are able to acquire skills from the lecture and th literature. They are able to test their knowledge using computer animations. They can test their level of knowledge by answering short questions and tests during the lecture. They are able to relate the acquired knowledge to other lectures (e.g. Electrical Engineering I-III and Mathematics I-III). They can familiarize themselves with a research topic and can prepare a presentation.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Course L0571: Research Seminar Electrical Engineering, Computer Science, Mathematics	
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des SD E
Language	DE/EN
Cycle	SoSe
Content	Seminar talk on a given subject
Literature	Themenabhängig / subject related

Course L0570: Transmission Line Theory		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Wave propagation along transmission lines</li> <li>Transient behavior of transmission lines</li> <li>Transmission lines in steady state</li> <li>Impedance transformation and Smith chart</li> <li>Equivalent circuits</li> <li>Coupled transmission lines and symmetrical components</li> </ul>	
Literature	- Unger, HG., "Elektromagnetische Wellen auf Leitungen", Hüthig Verlag (1991)	

Course L0572: Transmission Line Theory	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Par	tial Differential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Par	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Par	tial 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	I <u></u>			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>appropriate examples.</li> <li>Students can discuss logical cor illustrating these connections with</li> <li>They know proof strategies and ca</li> </ul>	the help of examples.	pts. They	are capable o
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in the course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work togeth common language.</li> <li>In doing so, they can communicate partners. Moreover, they can designeers.</li> </ul>	e new concepts according to the	needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking can specify open questions precise</li> <li>Students have developed sufficien oriented manner on hard problems</li> </ul>	ely and know where to get help in t persistence to be able to work f	solving the	m.
Workload in Hours	Independent Study Time 68, Study Time ir	Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration	60 min (Complex Functions) + 60 min (Dif			



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	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	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 Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
-	Mechatronics: Compulsory
r chowing curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Mechanical Engineering: Specialisation Mechatronics: 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)		
Тур	Typ Lecture	
Hrs/wk	2	
СР	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	<ul> <li>Main features of the theory and numerical treatment of partial differential equations</li> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	



Course L1044: Differential Equations 2 (Partial Differential Equations)		
Тур	Typ Recitation Section (small)	
Hrs/wk	1	
СР	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)	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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	
Тур	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	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	



Course L1041: Complex	ourse L1041: Complex Functions	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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	

se L1042: Complex Functions	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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 M0675: Int	roduction to Communications an	d Bandom Processes	s	
			5	
Courses Title		Тур	Hrs/wk	СР
	ons and Random Processes (L0442) ons and Random Processes (L0443)	Lecture Recitation Section (large)	3 1	4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematics 1-3</li> <li>Signals and Systems</li> <li>Basic knowledge of probability theory</li> </ul>			
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	The students know and understand the fundamental building blocks of a communications system They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.			
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method.			
Personal Competence				
Social Competence	The students can identify solve apositic problems			
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They car control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Tvp	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Gerhard Bauch		
Language	DE/EN		
Cycle	WiSe		
Content	<ul> <li>Fundamentals of random processes</li> <li>Introduction to communications engineering</li> <li>Quadrature amplitude modulation</li> <li>Description of radio frequency transmission in the equivalent complex baseband</li> <li>Transmission channels, channel models</li> <li>Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)</li> <li>Fundamentals of information theory, source coding, channel coding</li> <li>Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyque condition, matched filter, detection, error probability</li> <li>Fundamentals of digital modulation</li> </ul>		
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner. M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg. J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium. J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill. S. Haykin: Communication Systems. Wiley J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall. J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.		

Course L0443: Introduct	ourse L0443: Introduction to Communications and Random Processes		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Gerhard Bauch		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1235: Ele	ectrical Power Systems I			
Courses				
Title Electrical Power Systems I ( Electrical Power Systems I (		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Electrical Engineering			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	Students are able to give an overview of conventional and modern electric power systems. They can explain in detail and critically evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment into electric power systems.			
Skills	With completion of this module the students are able to apply the acquired skills in applications of the design, integration, development of electric power systems and to assess the results.			
Personal Competence				
	The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results in front of others.			
Autonomy	Students can independently tap knowledge of the emphasis of the lectures.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 - 150 minutes			
Assignment for the Following Curricula				



Course L1670: Electrical Power Systems I			
Typ Lecture			
Hrs/wk	s/wk 3		
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Christian Becker		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>fundamentals and current development trends in electric power engineering</li> <li>tasks and history of electric power systems</li> <li>symmetric three-phase systems</li> <li>fundamentals and modelling of eletric power systems <ul> <li>lines</li> <li>transformers</li> <li>synchronous machines</li> <li>induction machines</li> <li>loads and compensation</li> <li>grid structures and substations</li> </ul> </li> <li>fundamentals of energy conversion <ul> <li>electro-mechanical energy conversion</li> <li>thermodynamics</li> <li>power station technology</li> <li>renewable energy conversion systems</li> </ul> </li> <li>steady-state network calculation <ul> <li>network modelling</li> <li>load flow calculation</li> <li>(n-1)-criterion</li> <li>symmetric failure calculations, short-circuit power</li> <li>control in networks and power stations</li> <li>grid protection</li> <li>grid planning</li> <li>power economy fundamentals</li> </ul> </li> </ul>		
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008		



ourse L1671: Electrical Power Systems I			
Typ Recitation Section (large)			
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Christian Becker		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>thermodynamics</li> <li>power station technology</li> <li>renewable energy conversion systems</li> <li>steady-state network calculation         <ul> <li>network modelling</li> <li>load flow calculation</li> <li>(n-1)-criterion</li> </ul> </li> <li>symmetric failure calculations, short-circuit power</li> <li>control in networks and power stations</li> <li>grid protection</li> <li>grid planning</li> <li>power economy fundamentals</li> </ul>		
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008		

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Module M0783: Me	easurements: Methods and Data F	Processing		
Courses				
Title EE Experimental Lab (L0781 Measurements: Methods an Measurements: Methods an	d Data Processing (L0779)	<b>Typ</b> Practical Course Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements				
Recommended Previous Knowledge	principles of mathematics principles of electrical engineering			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain the purpose measurements. They can detail aspects of pro- stochastic signals. Students know methods to	bability theory and errors, an	d explain th	e processing of
Skills	The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements.			
Personal Competence				
Social Competence	The students solve problems in small groups.			
Autonomy	The students can reflect their knowledge and	discuss and evaluate their res	sults.	
Workload in Hours Credit points	Independent Study Time 110, Study Time in L	ecture /0		
	vritten exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German progra General Engineering Science (German progra Elective Compulsory Electrical Engineering: Core qualification: Cor General Engineering Science (English progra General Engineering Science (English progra Elective Compulsory Computational Science and Engineering: Spe Computational Science and Engineering: Spe Technomathematics: Specialisation III. Engine Technomathematics: Core qualification: Election	ram, 7 semester): Specialisat npulsory m): Specialisation Electrical E ram, 7 semester): Specialisat ecialisation Engineering Science ecialisation Computer Science pering Science: Elective Comp	tion Electric Engineering tion Electric nces: Elective Elective C	al Engineering: : Compulsory al Engineering: e Compulsory



Course L0781: EE Experimental Lab		
Тур	Typ Practical Course	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer, Prof. Christian Schuster, Prof. Thanh Trung Do, Prof. Rolf-Rainer Grigat, Prof. Arne Jacob, Prof. Herbert Werner, Dozenten des SD E, Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines	
Literature	Wird in der Lehrveranstaltung festgelegt	

Course L0779: Measurements: Methods and Data Processing		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	WiSe	
	introduction, systems and errors in metrology, probability theory, measuring stochastic signals, describing measurements, acquisition of analog signals, applied metrology	
Literature	Puente León, Kiencke: Messtechnik, Springer 2012 Lerch: Elektrische Messtechnik, Springer 2012 Weitere Literatur wird in der Veranstaltung bekanntgegeben.	

Course L0780: Measure	ourse L0780: Measurements: Methods and Data Processing	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
-	ering II: Time-Dependent Fields (L0182) ering II: Time-Dependent Fields (L0183)	Lecture Recitation Section (small)	3 2	5 1
	Prof. Christian Schuster			
Admission Requirements	None			
	Electrical Engineering I, Electrical Engineer	ing II, Theoretical Electrical Eng	ineering I	
Recommended Previous Knowledge	Mathematics I, Mathematics II, Mathematics	III, Mathematics IV		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional				
Competence				
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory time-dependent electromagnetic fields. They can assess the principal behavior and characteristics quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple field. The students are aware of applications for the theory of time-dependent electromagnetic fields and a able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of give time-dependent sources of fields and analyze these quantitatively. They can deduce meaningf quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poyntin vector, radiation resistance, etc.) from given fields and interpret them with regard to practic applications.			
Personal Competence				
•	Students are able to work together on sub	ect related tasks in small group	s. They are	able to prese
Social Competence	their results effectively (e.g. during exercise	sessions).		
Autonomy	Students are capable to gather necessary information from provided references and relate the information to the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the lectures and exercises that a related to the exam. Based on respective feedback, students are expected to adjust their individu learning process. They are able to draw connections between acquired knowledge and ongoin research at the Hamburg University of Technology (TUHH), e.g. in the area of high frequent engineering and optics.			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the	General Engineering Science (German pro General Engineering Science (German pr Compulsory Electrical Engineering: Core qualification: C General Engineering Science (English prog	ogram, 7 semester): Specialisa Compulsory	tion Electric	al Engineerin



 
 Following Curricula
 General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

 Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

 Technomathematics: Core qualification: Elective Compulsory

Turn	
⊺yp Hrs/wk	Lecture 2
CP	
	Independent Study Time 108, Study Time in Lecture 42
	Prof. Christian Schuster
Language	DE
Cycle	WiSe
	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
Content	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
Literature	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Schuster
Language	
Cycle	
	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
Content	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
Literature	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

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Module M0760: Ele	ectronic Devices			
Courses				
Title		Typ	Hrs/wk	СР
Electronic Devices (L0720) Electronic Devices (L0721)		Lecture Project-/problem-based Learning	3 2	4 2
Module Responsible	Prof. Hoc Khiem Trieu			
Admission Requirements				
Recommended	Atomic model and quantum theory, electric physics Successful participation of Physics for Engin with equivalent contents			
Educational Objectives	After taking part successfully, students have r	eached the following learnin	g results	
Professional Competence			-	
Knowledge	<ul> <li>Students are able</li> <li>to represent the basics of semiconductor physics,</li> <li>to explain the operating principle of important semiconductor devices,</li> <li>to outline device characteristics and equivalent circuits as well as to explain their deriva and</li> <li>to discuss the limitation of device models.</li> </ul>		their derivatio	
Skills	<ul> <li>Students are capable</li> <li>to apply devices in basic circuits,</li> <li>to realize the physical context and to a</li> </ul>	solve complex problems by o	neself	
Personal Competence				
Social Competence	Students are able to prepare and perform the discuss the results in front of audience.	ir lab experiments in team w	ork as well as	s to present an
Autonomy	Students are capable to acquire knowledge I	based on literature in order to	prepare thei	r experiments.
Workload in Hours	Independent Study Time 110, Study Time in	_ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the	General Engineering Science (German progr General Engineering Science (German progr Compulsory Electrical Engineering: Core qualification: Co General Engineering Science (English progr General Engineering Science (English progr Compulsory Computational Science and Engineering: Sp Compulsory	gram, 7 semester): Specialis mpulsory am): Specialisation Electrical ram, 7 semester): Specialis	ation Electric Engineering ation Electric	al Engineering : Compulsory al Engineering

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Turn	Lecture
Hrs/wk	
CP	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Hoc Khiem Trieu
Language	DE
Cycle	WiSe
Content	<ul> <li>Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagrar effective mass, density of state, probability of occupancy, mass action law, generation ar recombination processes, generation and recombination lifetime, carrier transpormechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconduct equations)</li> <li>pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunn diode, backward diode, photo diode, LED, laser diode)</li> <li>Bipolar transistor (principle of operation, current-voltage characteristics: calculation of bas collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect breakdown, generation and recombination current and high injection; Ebers-Moll model: fami of characteristics, equivalent circuit; frequency response, switching characteristic heterojunction bipolar transistor: operating principle, current-voltage characteristics, ohmic contar junction field effect transistor: operating principle, current-voltage characteristics, small-sign model, breakdown characteristics; MESFET: operating principle, depletion mode ar enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, stror inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS)</li> </ul>
Literature	<ul> <li>S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley &amp; Sons (1985)F. Thuse Physik der Halbleiterbauelemente, Springer (2011)</li> <li>T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung elektronischen Schaltungen, Springer (2004)</li> <li>B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)</li> <li>D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)</li> <li>M. Shur: Introduction to Electronic Devices, John Wiley &amp; Sons (1996)</li> <li>S.M. Sze: Physics of semiconductor devices, John Wiley &amp; Sons (2007)</li> <li>H. Schaumburg: Halbleiter, B.G. Teubner (1991)</li> <li>A. Möschwitzer: Grundlagen der Halbleiter-&amp;Mikroelektronik, Bd1 Elektronisch Halbleiterbauelemente, Carl Hanser (1992)</li> <li>HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalisch</li> </ul>



Course L0721: Electroni	urse L0721: Electronic Devices	
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Hoc Khiem Trieu	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	n time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequent response</li> <li>They can explain issues arising when controllers designed in continuous time domain a implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain a vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus a frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tir and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to ju	ointly solve technical problems, a	and experim	entally valida
Autonomy	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	e in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	n program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory
Process Engineering: Core qualification: Compulsory

Course L0654: Introduct	ion to Control Systems		
Тур	Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	ndependent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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 Root locus techniques Root locus design of PID controllers Frequency response techniques 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 Time delay systems Root locus and frequency response of time delay systems Simit predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course		
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, No. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Desi		Lecture	3	4
Semiconductor Circuit Desig	jn (L0864)	Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
- · ·	Fundamentals of electrical engineering			
Recommended Previous Knowledge	Basics of physics			
i i e nous i nome uge				
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
Knowledge	<ul> <li>Students are able to explain the functionality of different MOS devices in electronic circuits.</li> <li>Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.</li> <li>Students have solid knowledge about memory circuits and can explain their functionality and specifications.</li> <li>Students are able to explain how analog circuits functions and where they are applied.</li> <li>Students know the appropriate fields for the use of bipolar transistors.</li> </ul>			
Skills	<ul> <li>Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits.</li> <li>Students are able to develop different logic circuits and can design different types of log circuits.</li> <li>Students can use MOS devices, operational amplifiers and bipolar transistors for specifications.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able work efficiently in heterogeneous teams.</li> <li>Students working together in small groups can solve problems and answer professiona questions.</li> </ul>			
Autonomy	<ul> <li>Students are able to assess their let</li> </ul>	vel of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German pro General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory	program): Specialisation Mech ogram, 7 semester): Specialisa	anical Engi tion Electric	neering, Focu al Engineerin



	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory
	Mechanical Engineering: Specialisation Mechatronics: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Core qualification: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0763: Semiconductor Circuit Design			
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Matthias Kuhl		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul> From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).		
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</li> <li>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</li> <li>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>URL: http://www.ciando.com/img/bo</li> </ul>		



urse L0864: Semicon	ductor 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. Matthias Kuhl			
Language	DE			
Cycle	SoSe			
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>			
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011 ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</li> <li>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</li> <li>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>URL: http://www.ciando.com/img/bo</li> </ul>			



Module M0829: Fo	undations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Management	(L0880)	Lecture	3	3
Project Entrepreneurship (Lu	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission	None			
Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investmer and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations unde multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risl</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coher</li> </ul>		write a cohere	
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time ir	n Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Dioprocess Engineering: Computering General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: And Enviromenta Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

	Compulsory
G	eneral Engineering Science (English program, 7 semester): Specialisation Computer Science:
C	Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental ingineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Mechatronics: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Biomechanics: Compulsory
G	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Aircraft Systems Engineering: Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Materials in Engineering Sciences: Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Theoretical Mechanical Engineering: Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Product Development and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	computational Science and Engineering: Core qualification: Compulsory
L	ogistics and Mobility: Core qualification: Compulsory
N	lechanical Engineering: Core qualification: Compulsory
N	Arechatronics: Core qualification: Compulsory
N	laval Architecture: Core qualification: Compulsory
Т	echnomathematics: Core qualification: Compulsory
P	Process Engineering: Core qualification: Compulsory



Turn	Lecture		
тур Hrs/wk			
CP			
workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathri Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateg information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



Courses				
Title Electrical Engineering Project	et Laboratory (L0640)	<b>Typ</b> Project-/problem-based Learning	<b>Hrs/wk</b> 5	<b>CP</b> 6
Madula Paanansibla	Prof. Christian Becker	Loaining		
Admission				
Requirements	None			
	Electrical Engineering I, Electrical Enginee	ering II		
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate respective relationships. They are capable of describing an communicating relevant problems and questions using appropriate technical language. They ca			
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process or solving practical problems. They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently deriv solutions to given problems in the context of electrical engineering. They are able to effectively preser and explain their results alone or in groups in front of a qualified audience. Students have the ability the second students have the ability to be a second student of the se			
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and othe sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and scale	based on task + presentation			
Assignment for the Following Curricula	$\alpha$			



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory

Course L0640: Electrica	I Engineering Project Laboratory
Тур	Project-/problem-based Learning
Hrs/wk	5
CP	6
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Lecturer	Prof. Christian Becker, Dozenten des SD E
Language	DE
Cycle	SoSe
Content	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.
Literature	Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).

## **Specialization Energy and Enviromental Engineering**

One of the main challenges in modern society is the reliable, environmentally benign and sustainable supply of energy. An efficient energy supply is moreover essential to secure the economic future of the country.

The exponential increase in world population, the raised living standards and the continuously increasing hunger for feedstocks, acreage and energy make imperative the sustainable handling of natural resources. This includes the reduction of emissions and the minimisation of environmental impact. An example with growing significance is the control of the  $CO_2$  emissions that are responsible for the greenhouse effect. For this, possibilities are sought that bring energy savings or involve increased use of renewable energy sources. In a continued utilisation of fossil fuels the reduction of  $CO_2$  emissions is pursued by increasing efficiency and also through separation and underground storage of the  $CO_2$  emitted. The latter approaches make a close cooperation between Energy Engineering and Environmental Engineering unavoidable.

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science responds to two developments: on the one hand the increasing significance of environmental protection through CO<sub>2</sub> separation in large power stations and, on the other, the growing supply of electricity from regenerative energy sources. Both these key developments in electricity generation are taken into consideration in designing the degree course. Not only for the CO<sub>2</sub> separation technologies but also for other environmental protection purposes, as for example air pollution protection, key qualifications in Chemistry play an important role. Conventional and renewable electricity generation technologies are covered in the degree more detailed but still under a generalist viewpoint.

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science conveys a wide and well-founded multidisciplinary fundamental knowledge in the disciplines of Energy Engineering and of Environmental Engineering. Extending a well-grounded understanding in the core qualifications over basic engineering methods (mathematics, mechanics, thermodynamics, fluid mechanics, physics, chemistry, electrical engineering, informatics and engineering construction) additional skills are conveyed in energy technology, environmental assessment, environmental technology, materials science and particle technology, along with non-technical subjects. These provide necessary qualifications for elaborating the supporting processes during system development. At the skills level the Bachelor degree prepares the student for a Master study or even a PhD research too, so that after graduation also professional qualifications suitable for a potential future research career are gained.

Courses				
Title	Тур		Hrs/wk	СР
Computer Engineering (L03 Computer Engineering (L03	,	ture itation Section (small)	3 1	4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the	e following learning	results	
Professional Competence	<ul> <li>This module deals with the foundations of the function from the assembly-level programming down to gates. The Introduction</li> <li>Combinational logic: Gates, Boolean algebra</li> </ul>	he module includes	the following	g topics:





	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	r Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>



Course L0324: Compute	urse L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0933: Fu	ndamentals of Materials Science			
-				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S		Lecture	2	2
	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
Composites) (L0506) Physical and Chemical Basi	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and ca describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion ar 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 trace materials phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials phenom laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosid solidification, precipitation, or melting. The stud conditions and the materials microstructure, and t the material's behavior.	to mechanical properties on resistance, and to pha ents can explain the rel	such as stre se transform ation betwe	ength, ductility ations such a en processin
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
	Written exam			
Examination duration and scale	 180 min			
	General Engineering Science (German prog	ram): Specialisation E	nergy and	Enviroment
	Engineering: Compulsory			
	General Engineering Science (German pro	gram): Specialisation	Mechanical	Engineerin
	Compulsory General Engineering Science (German program):	Specialisation Biomedica	l Engineerin	a: Compulso
	General Engineering Science (German program): General Engineering Science (German program, 7 Compulsory	Specialisation Naval Arch	nitecture: Co	mpulsory
	General Engineering Science (German program,	7 semester): Specialisatio	n Biomedica	al Engineering
	Compulsory General Engineering Science (German progran Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		ecialisation	Energy an



Assignment for the Following Curricula	Engineering, Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L1085: Fundamentals of Materials Science I		
Тур	Lecture	
Hrs/wk	2	
СР	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	

Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)			
Тур	Lecture		
Hrs/wk			
СР	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		

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Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	<ul> <li>Motivation: "Atoms in Mechanical Engineering?"</li> <li>Basics: Force and Energy</li> <li>The electromagnetic Interaction <ul> <li>"Detour": Mathematics (complex e-funktion etc.)</li> </ul> </li> <li>The atom: Bohr's model of the atom</li> <li>Chemical bounds</li> <li>The multi part problem: Solutions and strategies</li> <li>Descriptions of using statistical thermodynamics</li> <li>Elastic theory of atoms</li> <li>Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)</li> </ul>
Literature	<ul> <li>Für den Elektromagnetismus:</li> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> <li>Für die Atomphysik: <ul> <li>Haken, Wolf: "Atom- und Quantenphysik", Springer</li> </ul> </li> <li>Für die Materialphysik und Elastizität: <ul> <li>Hornbogen, Warlimont: "Metallkunde", Springer</li> </ul> </li> </ul>



Title Embodiment Design and 3D Mechanical Design Project I Mechanical Design Project I Team Project Design Metho Module Responsible Admission Requirements	I (L0695) II (L0592) Idology (L0267)	<b>Typ</b> Lecture Practical Course Practical Course Project-/problem-based Learning	Hrs/wk 2 3	<b>CP</b>
Mechanical Design Project I Mechanical Design Project I Team Project Design Metho Module Responsible Admission	I (L0695) II (L0592) Idology (L0267)	Practical Course Practical Course Project-/problem-based		1
Mechanical Design Project I Team Project Design Metho Module Responsible Admission	II (L0592) dology (L0267)	Practical Course Project-/problem-based	3	
Team Project Design Metho Module Responsible Admission	dology (L0267)	Project-/problem-based	-	2
Module Responsible Admission			3	2
Admission	Prof. Dieter Krause	Ecarring	2	1
	INODE			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learni	ng results	
Professional				
Competence	1			
	After passing the module, students a	re able to:		
Knowledge		r machinery parts e.g. considering gineering designing.	load situatior	ı, materials and
	After passing the module, students a			
Skills	<ul> <li>design components based or</li> <li>dimension (calculate) used c</li> </ul>	olve engineering design tasks systa	-	-
Personal Competence				
	After passing the module, students a	re able to:		
Social Competence	<ul> <li>moderate the use of scientific</li> </ul>	s and technical drawings within grou	-	ecisions,
	Students are able			
Autonomy	<ul> <li>to estimate their level of kn clickers),</li> <li>To solve engineering design</li> </ul>	owledge using activating methods tasks systematically.	s within the lea	ctures (e.g. with
Workload in Hours	Independent Study Time 40, Study T	ime in Lecture 140		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science ( Engineering: Compulsory General Engineering Science ( Compulsory General Engineering Science (Germ General Engineering Science (Germ	German program): Specialisation an program): Specialisation Biomed	n Mechanica lical Engineeri	I Engineering



	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Naval Architecture: Core qualification: Compulsory

Course L0268: Embodim	nent Design and 3D-CAD
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0695: Mechanic	cal Design Project I
Тур	Practical Course
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>

Course L0592: Mechanie	cal Design Project II
Тур	Practical Course
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	SoSe
Content	<ul> <li>Generation of sketches for functions and sub-functions</li> <li>Approximately calculation of shafts</li> <li>Dimension of bearings, screw connections and weld</li> <li>Generation of engineering drawings (assembly drawings, manufacturing drawing)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.</li> <li>Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.</li> <li>Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.</li> <li>Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.</li> </ul>



Course L0267: Team Pro	oject Design Methodology
Тур	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> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Courses				
<b>Title</b> Fundamentals of Fluid Mech Fluid Mechanics for Process		<b>Typ</b> Lecture Recitation Section (lar	Hrs/wk 2 ge) 2	<b>CP</b> 4 2
Module Responsible	Prof. Michael Schlüter			
A duo io o io u				
Requirements				
Recommended Previous Knowledge	<ul> <li>Mathematics I+II+III</li> <li>Technical Mechanics I+II</li> <li>Technical Thermodynamics I+II</li> <li>Working with force balances</li> <li>Simplification and solving of pa</li> <li>Integration</li> </ul>			
Educational Objectives	After taking part successfully, students	have reached the following lear	ning results	
Professional Competence				
Knowledge	<ul> <li>Students are able to:</li> <li>explain the difference between</li> <li>give an overview for different engineering</li> <li>explain simplifications of the boundary conditions</li> </ul>	applications of the Reynolds	-	
Skills	<ul> <li>The students are able to</li> <li>describe and model incompres</li> <li>reduce the governing equation solutions e.g. by integration</li> <li>notice the dependency betwee</li> <li>use the learned basics for fluid</li> </ul>	ns of fluid mechanics by simpli	ns	
Personal Competence				
Social Competence	<ul> <li>The students</li> <li>are capable to gather information information to the context of the</li> <li>able to work together on subject results effectively in English (e.)</li> <li>are able to work out solutions for present the results.</li> </ul>	lecture and ect related tasks in small groups g. during small group exercises)	. They are able	e to present the
Autonomy	<ul> <li>The students are able to</li> <li>search further literature for each</li> <li>work on their exercises by their</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Ti	me in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German General Engineering Science (German General Engineering Science (Ge Engineering: Compulsory	n program): Specialisation Biopr	ocess Engineer	ing: Compulso



Assignment for the Following Curricula	Energy and Environmental Engineering. Core qualification: Compulsory
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Course L0091: Fundame	entals of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	<ul> <li>fluid properties</li> <li>hydrostatic</li> <li>overall balances - theory of streamline</li> <li>overall balances- conservation equations</li> <li>differential balances - Navier Stokes equations</li> <li>irrotational flows - Potenzialströmungen</li> <li>flow around bodies - theory of physical similarity</li> <li>turbulent flows</li> <li>compressible flows</li> </ul>
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011</li> </ol>



Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented or the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chall board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212 2011</li> </ol>



ourses			
			00
i <b>tle</b> lectrical Machines (L0293)		lrs/wk	<b>CP</b> 4
lectrical Machines (L0293)	,		4 2
Module Responsible	, , , , , , , , , , , , , , , , , , ,		_
Admission Requirements			
Requirements	None		
<b>D</b>	Basics of mathematics, in particular complexe numbers, integrals, differentials		
Recommended Previous Knowledge	Basics of electrical engineering and mechanical engineering		
ducational Objectives	After taking part successfully, students have reached the following learning res	sults	
Professional			
Competence			
	Students can to draw and explain the basic principles of electric and magnetic	c fields.	
Knowledge	They can describe the function of the standard types of electric made corresponding equations and characteristic curves. For typically used drives major parameters of the energy efficiency of the whole system from the p engine.	es they ca	n explain
	Students arw able to calculate two-dimensional electric and magnetic fields in circuits with air gap. For this they apply the usual methods of the design auf ele	-	-
Skills	They can calulate the operational performance of electric machines from their and selected quantities and characteristic curves. They apply the usual graphical methods.		
Personal Competence			
Personal Competence Social Competence			
Social Competence		es from the	
Social Competence Autonomy	Students are able independently to calculate electric and magnatic fields fo able to analyse independently the operational performance of electric machine data and theycan calculate thereof selected quantities and characteristic curve	es from the	
Social Competence Autonomy	None Students are able independently to calculate electric and magnatic fields fo able to analyse independently the operational performance of electric machine data and theycan calculate thereof selected quantities and characteristic curve Independent Study Time 110, Study Time in Lecture 70	es from the	
Social Competence Autonomy Workload in Hours Credit points	None Students are able independently to calculate electric and magnatic fields fo able to analyse independently the operational performance of electric machine data and theycan calculate thereof selected quantities and characteristic curve Independent Study Time 110, Study Time in Lecture 70	es from the	
Social Competence Autonomy Workload in Hours Credit points	none         Students are able independently to calculate electric and magnatic fields fo         able to analyse independently the operational performance of electric machine         data and theycan calculate thereof selected quantities and characteristic curve         a Independent Study Time 110, Study Time in Lecture 70         6         Written exam         120 Minuton	es from the	e characters



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Elective Compulsory
Mechatronics: Core qualification: Compulsory

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



Course L0294: Electrical Machines				
Тур	Recitation Section (large)			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Trung Do Thanh, Weitere Mitarbeiter			
Language	DE			
Cycle	SoSe			
Content	Exercises to the application of electric and magnetic fields. Excercises to the operational performance of eletric machines.			
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"			

Γ



Module M0618: Re	newables and Energy Systems			
Courses				
<b>Title</b> Power Industry (L0316) Energy Systems and Energy Renewable Energy (L0313)	y Industry (L0315)	Typ Lecture Lecture Lecture	<b>Hrs/wk</b> 1 2 2	<b>CP</b> 1 2 2
Renewable Energy (L1434)		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt	· · · · ·		
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	With completion of this module, the students can provide an overview of characteristics of energy systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them. Furthermore, the students can explain the environmental benefits from the use of such systems.			
Students are able to apply methodologies for detailed determination of energy demand o production for various types of energy systems. Furthermore, they can evaluate energy technically, environmentally and economically and design them under certain given contract the technical solutions of a problem. <i>Skills</i> The students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions and possible approaches to its processing from the students are able to explain questions are able to		energy system ven conditions ot standardize		
<b>D</b>	renewable energies orally and to put them them i	into the right context.		
Personal Competence Social Competence	The students are able to analyze suitable techn economical and ecological criteria under sustain contribuition to a more sustainable power supply	ability aspects. This allows		
Autonomy	Students can independently exploit sources , acc and transform it to new questions.	quire the particular knowle	dge about t	he subject are
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours written exam			
	General Engineering Science (German pro Engineering: Compulsory General Engineering Science (German pro Enviromental Engineering: Compulsory General Engineering Science (German program, Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core qu General Engineering Science (English pro Engineering: Compulsory General Engineering Science (English program,	ogram, 7 semester): Sp ,7 semester): Specialisatio alification: Compulsory gram): Specialisation E	n Mechanic nergy and	Energy and al Engineering Enviromenta



Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory

Course L0316: Power Industry			
Тур	Lecture		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Kaltschmitt, Prof. Andreas Wiese		
Language	DE		
Cycle	SoSe		
Language       DE         Cycle       SoSe         • Electrical energy in the energy system         • Demand and use of electrical energy (households, industry, "new" buyers mobility))         • Electricity generation         • electricity generation technologies using fossil fuels and their characteristi         • combined heat and power technologies and their production characteristi         • electricity generation from renewable energy technologies and their characteristi         • electricity generation form renewable energy technologies and their characteristi         • challenges of fluctuating electricity generation by distributed system market, electricity stock exchange, emissions trading)         • District heating industry         • Legal and administrative aspects         • Energy Act         • support instruments for renewable energy         • CHP Act         • Cost and efficiency calculation			
Literature	Folien der Vorlesung		

Course L0315: Energy Systems and Energy Industry			
Тур	ecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Energy: development and significance</li> <li>Fundamentals and basic concepts</li> <li>Energy demand and future trends (heat, electricity, fuels)</li> <li>Energy reserve and sources</li> <li>Cost and efficiency calculation</li> <li>Final and effective energy from petroleum, natural gas, coal, uranium and other</li> <li>Legal, administrative and organizational aspects of energy systems</li> <li>Energy systems as a permanent optimization task</li> </ul>		
Literature	Kopien der Folien		



Course L0313: Renewak	Course L0313: Renewable Energy			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Martin Kaltschmitt			
Language	DE/EN			
Cycle	SoSe			
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>			
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>			

Course L1434: Renewable Energy			
Typ Recitation Section (small)			
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE/EN		
Cycle	SoSe		
Cycle       SoSe         Students work on different tasks in the field of renewable energies. They present their solution exercise lesson and discuss it with other students and the lecturer.         Possible tasks in the field of renewable energies are:         • Solar thermal heat         • Concentrating solare power         • Photovoltaic         • Windenergie         • Hydropower         • Deep geothermal energy			
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		



Courses				
Measurement Technology for	nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118)	<b>Typ</b> Practical Course Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible				
A dusis sis u				
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ectrical engineering		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).			
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-		
	They can describe important methods of o Chromatography)	chemical Analysis (Gas Se	ensors, Spe	ctroscopy, G
Skills	Students can select suitable measuring measurement devices in practice. The students are able to orally explain issue solution approaches as well as place the issue	es in the subject area of me	asurement	technology ar
Personal Competence	Students can arrive at work results in groups a	nd document them in a comn	non report.	
Social Competence				
Autonomy	Students are able to familiarize themselves wit	h new measurement technol	ogies.	
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points Examination				
Examination Examination duration and scale	105 minutes			
	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory Energy and Environmental Engineering: Core	program): Specialisation m): Specialisation Biomedica m): Specialisation Process E program, 7 semester): Sp m, 7 semester): Specialisation m, 7 semester): Specialisation ram, 7 semester): Specialisation	Mechanica al Engineeri ingineering: becialisatior on Mechanic on Biomedic	I Engineerin ng: Compulso Compulsory Energy a cal Engineerin cal Engineerin



Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Process Engineering: Core qualification: Compulsory



Course L1119: Practica	Course: Measurement and Control Systems
	Practical Course
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	DE
	WiSe/SoSe
`	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



urse L1116: Measurement Technology for Mechanical and Process Engineers		
	Lecture	
Hrs/wk CP		
	Independent Study Time 62, Study Time in Lecture 28	
	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
	1 Fundamentals	
	1.1 Quantities and Units	
	1.2 Uncertainty	
	1.3 Calibration	
	1.4 Static and Dynamic Properties of Sensors and Systems	
	2 Measurement of Electrical Quantities	
	2.1 Current and Voltage	
	2.2 Impedance	
	2.3 Amplification	
	2.4 Oscilloscope	
	2.5 Analog-to-Digital Conversion	
Content	2.6 Data Transmission	
Content	3 Measurement of Nonelectric Quantities	
	3.1 Temperature	
	3.2 Length, Displacement, Angle	
	3.3 Strain, Force, Pressure	
	3.4 Flow	
	3.5 Time, Frequency	
	4 Chemical Analysis	
	4.1 Gas Sensors	
	4.2 Spectroscopy	
	4.3 Gas Chromatography	
	At the end of each lecture students present single measuring techniques and results orally in front the class.	
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.	
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940.	



Course L1118: Measure	urse L1118: Measurement Technology for Mechanical and Process Engineers	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (L1387) Environmental Technologie (L0326)		Practical Course Lecture	1 2	1 2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemi	stry and biology		
Educational Objectives	After taking part successfully, students have	ve reached the following learr	ning results	
Professional Competence				
	With the completion of this modul the students obtain profound knowledge of environmenta technology. They are able to describe the behaviour of chemicals in the environment. Students ca give an overview of scientific disciplines involved. They can explain terms and allocate them to relate methods.			
Skills	Students are able to propose appropriate management and mitigation measures for environmenta problems. They are able to determine geochemical parameters and to assess the potential or pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.			
Personal Competence				
	The students are able to discuss the various technical and scientific tasks, both subject-specific an multidiscipling to the task of a group of well on the task of a group of tasks.			
	Students can independently exploit sources about of the subject, acquire the particular knowledge an tranfer it to new problems.			
Workload in Hours	Independent Study Time 48, Study Time in	n Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour			
Assignment for the Following Curricula	FUELOV ADO FUVICOMENIAL FUOMEENDO, GOLE ODAMICANOU, GOMDUISOV			

## Process Engineering: Core qualification: Elective Compulsory

TUHH

Course L1387: Practical	Exercise Environmental Technology	
Тур	Practical Course	
Hrs/wk		
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Joachim Gerth	
Language	DE	
Cycle	SoSe	
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515	

Course L0326: Environm	nental Technologie
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta
Language	DE
Cycle	WiSe
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)



	at and Mass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (LC Heat and Mass Transfer (LC		Lecture Recitation Section (small)	2 1	2 2
Heat and Mass Transfer (L	,	Recitation Section (Iarge)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynam	ics		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>procedural apparatus (e. g. heat exc</li> <li>They are capable of distinguish an namely heat conduction, heat transf</li> <li>The students have the ability to ex describe mass transfer qualitative at</li> <li>They are able to depict the analogy linked processes in detail.</li> </ul>	d characterize different kinds o er and thermal radiation. plain the physical basis for ma nd quantitative by using suitable	ss transfer mass trans	in detail and fer theories.
Skills	<ul> <li>The students are able to set reason using the gained knowledge and respectively.</li> <li>They are capable to solve specific temperature alteration in fluids) and</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish betwee They can use this knowledge for column, rectification column).</li> <li>In this context, the students are cap mass exchanger for a specific app respectively.</li> <li>In addition, they can calculate both, apparatus.</li> <li>The students are capable to conne of other courses (In particular the process engineering) to solve concrete.</li> </ul>	I to balance the correspondin c heat transfer problems (e.g. to calculate the corresponding l e students can execute scaling u en diffusion, convective mass tr the description and design of pable to choose and design fun- lication considering their advan steady-state and non-steady-state ct their knowledge obtained in t courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flow emical reactor cal processes d mass transfe (e.g. extraction pes of heat ar disadvantage es in procedur with knowlego
Personal Competence Social Competence	<ul> <li>The students are capable to work or results orally in a reasonable manner.</li> </ul>		n teams and	d to present th
	<ul> <li>The students are able to find and ev</li> <li>They are able to prove their lev procedure continuously (clicker-system)</li> </ul>	el of knowledge during the c	ourse with	accompanyir



Autonomy	control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory



Course L0101: Heat and Mass Transfer		
Тур	Typ Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	<ol> <li>Heat transfer         <ul> <li>Introduction, one-dimensional heat conduction</li> <li>Convective heat transfer</li> <li>Multidimensional heat conduction</li> <li>Non-steady heat conduction</li> <li>Thermal radiation</li> </ul> </li> <li>Mass transfer         <ul> <li>one-way diffusion, equimolar countercurrent diffusion</li> <li>boundary layer theory, non-steady mass transfer</li> <li>Heat and mass transfer single particle/ fixed bed</li> <li>Mass transfer and chemical reactions</li> </ul> </li> </ol>	
Literature	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>	

Course L0102: Heat and	Course L0102: Heat and Mass Transfer	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Process Thermal Separation Process		Lecture Recitation Section (small)	2 2	2 2
Thermal Separation Process		Recitation Section (Iarge)	2	2
Separation Processes (L115		Practical Course	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynam	ics III		
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>distillation, extraction, and adsorption</li> <li>The students develop an understand process, the estimation of the energy and the selection of separation system</li> <li>They have good knowledge of design</li> </ul>	demand of a process, the po ns	ssibilities o	f energy saving
Skills	<ul> <li>Using the gained knowledge the stud separation process and can close the</li> <li>The students can use different graph and define the amount of theoretical s</li> <li>They can select and design a basic ty on the advantages and disadvantage</li> <li>The students are capable to obtai appropriate sources (diagrams and ta</li> <li>They can calculate continuous and di</li> <li>The students are able to prove their th</li> <li>The students are able to discuss experimental work with the teachers in</li> </ul>	associated energy and mater nical methods for the designin tages required ype of thermal separation proc s of the process n independently the needed bles) scontinuous processes reoretical knowledge in the ex the theoretical background n colloquium.	al balances ng of a sep cess for a gi d material perimental l and the nt of other l	aration proces ven case base properties from ab work. content of th ectures and us
Personal Competence	<ul> <li>The students can work technical as</li> </ul>	signments in small groups a	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out pradivision of labor between them. They scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to obta themselves and assess their quality</li> <li>The students can proof the state of th this way control their learning process</li> </ul>	eir knowledge with exam rese		



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	Energy and Environmental Engineering: ( 'ore gualitication: ( 'ompulsory



Тур	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	DE
Cycle	
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separatio processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter d Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and th application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1 ; ISBN 0-387-91477-3 .</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry''s Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg. 6th ed., McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technische Chemie</li> </ul>



Түр	Recitation Section (small)		
Hrs/wk	2		
СР			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle			
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th endocy McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technischen Chemie</li> </ul>		



ourse L0141: Thermal	Separation Processes		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technischen Chemie</li> </ul>		



urse L1159: Separatio			
ryp Hrs/wk	Practical Course		
CP			
	Independent Study Time 16, Study Time in Lecture 14		
	Compulsory attendence of the colloquia of all experiments and compulsory report.		
	Prof. Irina Smirnova		
Language			
Cycle			
Content	<ul> <li>The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.</li> <li>The students work small groups with a high degree of division of labor. For every experiment, the students work a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.</li> <li>Topics of the practical course: <ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul> </li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3: 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



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Courses				
Title		Тур	Hrs/wk	CP
Gas and Steam Power Plan		Lecture	3	4
Gas and Steam Power Plan		Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
nequirements				
Recommended	<ul> <li>"Technical Thermodynamics I and I</li> </ul>	"		
Previous Knowledge	"Heat Transfer"     "Etrid Masharias"			
-	"Fluid Mechanics"			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
Knowledge	routes in the thermal power plant, describe the various types of power plant and the layout of the steam generator block. They are also able to determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.			
	The students have basic knowledge about The students will be able, using theories a		-	-
Skills	based on well-founded knowledge on the identify basic associations in the produc solutions. Through analysis of the problem power generation the students are endown optimal concepts for the generation of elect the students become the ability to follow within the energy-political triangle (econom	tion of heat and electricity, so and exposure to the inherent i ed with the capability and metho tricity and the production of heat better the deliberations on the	as to deve nterplay be odology to c t. From the t electricity n	lop conceptu tween heat a levelop realis echnical basi nix compositio
	Within the framework of the exercise the students learn the use of the specialised software suit EBSILON Professional <sup>TM</sup> . With this tool small practical tasks are solved with the PC, to highligh aspects of the design and development of power plant cycles.			
	The students are able to do simplified ca single component or at stage level.	lculations on turbomachinery e	ither as pai	t of a plant, a
Personal Competence				
Social Competence	An excursion within the framework of the lecture is planned for students that are interested. Th			
Autonomy	The students assisted by the tutors will be able to develop alone simple simulation models and run with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary conditions highlighted. The students are able independently to analyse the operational performance of steam			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
-	Written exam			



and scale	General Engineering Science (German program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Elective Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Elective Compulsory
	Mechanical Engineering: Specialisation Energy Systems: Compulsory



Course L0206: Gas and	Steam Power Plants		
Тур	Lecture		
Hrs/wk	3		
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Alfons Kather		
Language	DE		
Cycle	WiSe		
Content	In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including: <ul> <li>Electricity demand and Forecasting</li> <li>Thermodynamic fundamentals</li> <li>Energy Conversion in thermal power plants</li> <li>Types of power plant</li> <li>Layout of the power plant block</li> <li>Individual elements of the power plant</li> <li>Cooling systems</li> <li>Flue gas cleaning</li> <li>Operation characteristics of the power plants</li> <li>Location of power plants</li> <li>Solar thermal plants/Garbon Capture and Storage plants.</li> </ul> These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues: <ul> <li>Energy balance of a turbomachine</li> <li>Theory of turbine and compressor stage</li> <li>Equal and positive pressure blading</li> <li>Flow losses</li> <li>Axial and radial design</li> <li>Design features</li> <li>Hydraulic turbomachines</li> <li>Pump and water turbine designs</li> <li>Design examples of reciprocating engines and turbomachinery</li> <li>Steam power plants</li> </ul>		
Literature	<ul> <li>Kalide: Kraft- und Arbeitsmaschinen</li> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul>		



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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible				
Admission Requirements				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	pintly solve technical problems, a	and experim	entally valida
Autonomy	Their controller designs 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	e in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory
Process Engineering: Core qualification: Compulsory

Course L0654: Introduct	ion to Control Systems	
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	rof. Herbert Werner	
Language	<u>E</u>	
Cycle	WiSe	
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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 Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Frequency response interpretation of PID control Simit predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course	
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, No. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>	



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
<b>Title</b> Particle Technology I (L043) Particle Technology I (L043) Particle Technology I (L044)	5)	<b>Typ</b> Lecture Recitation Section (small) Practical Course	<b>Hrs/wk</b> 2 1 2	<b>CP</b> 3 1 2
Module Responsible	·		_	_
Admission Requirements	None			
Recommended Previous Knowledge	keine			
-	After taking part successfully, students have a	reached the following learning	results	
Professional Competence	After successful completion of the module stu			
Knowledge	<ul> <li>name and explain processes and unit-operations of solids process engineering,</li> <li>characterize particles, particle distributions and to discuss their bulk properties</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>choose and design apparatuses and solids properties of the product</li> <li>asses solids with respect to their behated document their work scientifically.</li> </ul>		-	g to the desir
Personal Competence				
Social Competence	The students are able to discuss scientific to develop solutions for technical-scientific issued to the state of the state		or scientific	personal and
Autonomy	Students are able to analyze and solve ques		ndependen	tly.
Credit points	Independent Study Time 110, Study Time in	Lecture 70		
-	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (German program): Specialisation Energy and Environmenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy an Environmental Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory			



### Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course L0434: Particle		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Heinrich	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>	
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.	

Course L0435: Particle Technology I	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Osena LOAAO Destinte I	Parkan I.
Course L0440: Particle	lechnology I
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment	(L0860)	Lecture	2	2
Environmental Assessment	(L1054)	Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemi	stry and biology		
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the stuchains of potential environmental problem construction measures. They have knowl in dealing with different methods and i students are able to estimate the complex and difficulties with their measurement.	ns which might occur from produ edge about the methodological on nstruments to assess environm	ction proces diversity and ental impac	ses, projects l are compete ts. Besides th
Skills	The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity and consciousness towards these subjects are raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process a carry out independent scientific work. The and are able to judge results of other publ	ey can solve an environmental pro		-
Workload in Hours	Independent Study Time 48, Study Time in	n Lecture 42		
Credit points	i			
-	Written exam			
Examination duration and scale	1 hour written exam			
	General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Elective Compulsory General Engineering Science (German pu Elective Compulsory Bioprocess Engineering: Core qualificatio Energy and Environmental Engineering: C	n program): Specialisation Proc an program, 7 semester): S program, 7 semester): Specialis rogram, 7 semester): Specialisation: Elective Compulsory	cess Engine pecialisation ation Proces	eering: Electiv Energy ar ss Engineerin
Assignment for the		construction. computery		

#### TUHH Hamburg University of Technolog

Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Process Engineering: Elective	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:	
	Elective Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	
	Elective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory	
	Process Engineering: Core qualification: Compulsory	

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
Content	Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment , SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	



Course L1054: Environmental Assessment		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE	
Cycle	SoSe	
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject- specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	Power point Präsentationen	



Module M0891: Inf	ormatics for Process Engir	ieers			
Courses					
Title Informatics for Process Eng	incore (1.0836)	<b>Typ</b> Lecture		Hrs/wk 2	<b>CP</b> 2
Informatics for Process Eng			on Section (small)	2	2
Numeric and Matlab (L0125)		Practica	l Course	2	2
Module Responsible	Dr. Marcus Venzke				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in using MS Windo	WS.			
Educational Objectives	After taking part successfully, student	s have reached the fo	llowing learning	results	
Professional Competence					
	Students can describe procedural an	d object-oriented con	cepts.		
Knowledge					
Skills	Students are capable of object-oriented programming in the programing language Java and of solving mathematic questions by using Matlab. Students are capable of developing concepts (simple algorithms) to solve technical questions.				
Personal Competence Social Competence	Students are able to work out solution	ns together in small g	roups.		
Autonomy	Students are able to assess acquired	l skills by applying it i	n practice.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula					



Course L0836: Informati	ics for Process Engineers
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	Introduction to object-oriented modelling and programming exemplified with Java <ul> <li>Objects, classes</li> <li>Methods, properties</li> <li>Inheritance</li> <li>Basics of the language Java</li> <li>Sample application: Simulation of an electricity network</li> <li>2D graphics</li> <li>Events and Controls</li> </ul>
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison- Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/



Course L0837: Informati	cs for Process Engineers	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Marcus Venzke	
Language	DE	
Cycle	SoSe	
Content	In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor.	
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison- Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/	

ourse L0125: Numeric and Matlab	
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>
Literature	Literatur (Software-Teil): <ol> <li>Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007</li> <li>Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de</li> <li>Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>



Courses				
Title Process and Plant Engineer Process and Plant Engineer Process and Plant Engineer	ing I (L0096)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Georg Fieg			
Admission Requirements	None			
Recommended Previous Knowledge	unit operation of thermal an dmechanical s chemical reactor eingineering	eparation processes		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	students can: classify and formulate blobal balance equa specify linear component equations of com explain linear regression and data reconcil	plex chemical processes		
Skills	explain pfd-diagrams students are capable of - formulation of mass and energy balance e - estimation of component streams of chem - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and the	ical plants using linear compone		
Personal Competence				
Social Competence				
Autonomy		<del>-</del>		
Credit points	Independent Study Time 124, Study Time i	n Lecture 56		
-	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Enviromental Engineering: Elective Compu Bioprocess Engineering: Core qualification General Engineering Science (English pro General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory	gram): Specialisation Bioproces rogram, 7 semester): Specialisation ogram, 7 semester): Specialisation n program, 7 semester): Sp ulsory p: Compulsory gram): Specialisation Bioprocess gram): Specialisation Process En rogram, 7 semester): Specialisation	as Engineeri ation Proces on Bioproce decialisation s Engineering ngineering: ation Proces	ng: Compulso ss Engineerin ss Engineerin n Energy an ng: Compulsor Compulsory ss Engineerin



General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory

ourse L0095: Process	and Plant Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	
	Prof. Georg Fieg
Language Cycle	
Content	<ol> <li>Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants         Engineering methods and tools         Mass and energy balances         Strategies of process synthesis         Graphical representation of processes         Multidimensional regression         Data reconciliation and data validation         Process Synthesis         Decision levels         Experimental process development         Reactor synthesis         Synthesis of separation processes (process alternatives and criteria for selection)         Integration of reaction systems/separation systems (interactions, recycle streams)         Process safety         Sourcess, capital costs, economic evaluation         A Production costs, capital costs, economic evaluation         A production plants         A production plants         Production costs, capital costs, economic evaluation         A production plants         A production plants         A production costs, capital costs, economic evaluation         A production costs, capital costs, economic evaluation         A production costs, capital costs, economic evaluation         A production plants         A production plant</li></ol>
	<ul> <li>S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679</li> <li>H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74</li> <li>Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157</li> <li>E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997</li> <li>M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916</li> <li>R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&amp;Co.KGaA, Weinheim, 2004</li> <li>J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988</li> <li>G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19</li> <li>G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306</li> <li>G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213</li> <li>G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133</li> <li>U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlur Blazek und Bergamann, Frankfurt, 2000</li> </ul>

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Literature	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
	G. Kaibel, Dissertation, TU München, 1987
	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process and Plant Engineering I	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Course work	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1214: Process	ourse L1214: Process and Plant Engineering I	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (Lu		Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, informatio management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under ris</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>		write a coherer	
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
-	Subject theoretical and practical work			
	· · · · · · · · · · · · · · · · · · ·			



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Dioprocess Engineering, computering General Engineering Science (German program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

Compulsory	
General Engineering Science (English	program, 7 semester): Specialisation Computer Science:
Compulsory	
General Engineering Science (English p Compulsory	rogram, 7 semester): Specialisation Bioprocess Engineering:
General Engineering Science (English	n program, 7 semester): Specialisation Civil Engineering:
Compulsory	rearrow 7 competers): Providiantian Energy and Environmental
Engineering: Compulsory	rogram, 7 semester): Specialisation Energy and Enviromental
General Engineering Science (English p Focus Mechatronics: Compulsory	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
General Engineering Science (English p Focus Aircraft Systems Engineering: Con	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
•	rogram, 7 semester): Specialisation Mechanical Engineering,
	rogram, 7 semester): Specialisation Mechanical Engineering,
Computational Science and Engineering	: Core qualification: Compulsory
Computational Science and Engineering	
Logistics and Mobility: Core qualification	
Mechanical Engineering: Core qualificati	
Mechatronics: Core qualification: Compu	
Naval Architecture: Core qualification: Co	•
Technomathematics: Core qualification:	
Process Engineering: Core qualification:	Compulsory



Typ	Lecture	
Hrs/wk		
CP		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>	



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



## **Specialization Computer Science**

The specialization in "Computer Science" allows the graduates to work in the IT sector and to enter Master studies. The Graduates are able to cooperate with Computer Scientists for the design and realization of complex IT tasks. The Graduates should be in the position to adapt to new developments. They should be able to become professionals in almost all branches.

The specialization in "Computer Science" consists of core courses in fundamentals of mathematics and computer science, and specialized courses in software or hardware.

# Module M0561: Discrete Algebraic Structures

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Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures (L0164)		Lecture	2	3
Discrete Algebraic Structure	es (L0165)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics from High School.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic structures including elementary combinatorial structures, monoids, groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a group and to present the results accordingly			
Autonomy	Students are able to acquire new knowledge acquired knowledge to other classes.	from specific standard b	ooks and to	o associate the
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points				
	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory			



Course L0164: Discrete	ourse L0164: Discrete Algebraic Structures		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann		
Language	DE		
Cycle	WiSe		
Content			
Literature			

	Algebraic Structures
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Karl-Heinz Zimmermann
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
A duoio o io u	None			
Requirements				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence	This module deals with the foundations of the fun	octionality of computing a	evetame lt co	ware the lave
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architectu pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses</li> </ul>			
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the inter structure and the physical composition of computer systems. The students can analyze, how hig specific and individual computers can be built based on a collection of few and simple compone They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they sl understand the consequences that the execution of software has on the hardware-centric abstract layers from the assembly language down to gates. This way, they will be enabled to evaluate impact that these low abstraction levels have on an entire system's performance and to proper feasible options.		ze, how high le component yers of today rdependencie ilar, they sha htric abstractio to evaluate th	
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly
	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate	this knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Core gualification: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory

# Technomathematics: Specialisation II. Informatics: Elective Compulsory

TUHH

Course L0321: Compute	er Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer Engineering		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
	g, Algorithms and Data Structures (L0131) g, Algorithms and Data Structures (L0132)	Lecture Recitation Section (small)	4 1	4 2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence Knowledge				
Skills	<ul> <li>Students are able to</li> <li>Design software using given design</li> <li>Carry out software development ar Test</li> <li>Sort and search for data efficiently</li> <li>Assess the complexity of algorithms.</li> </ul>	nd tests using version manage		
Personal Competence	Students can work in teams and communica	ate in forums.		
Autonomy	Students are able to solve programming tasks such as LZW data compression using SVN Reposito and Google Test independently and over a period of two to three weeks.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
	Written exam			
Examination				



	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Technomathematics: Core qualification: Compulsory

ourse L0131: Objector	ented Programming, Algorithms and Data Structures
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Rolf-Rainer Grigat
Language	DE
Cycle	SoSe
Content	<ul> <li>Object oriented analysis and design:</li> <li>Objectoriented programming in C++ and Java</li> <li>generic programming</li> <li>UML</li> <li>design patterns</li> </ul> Data structures and algorithmes: <ul> <li>complexity of algorithms</li> <li>searching, sorting, hash tables,</li> <li>stack, queues, lists,</li> <li>trees (AVL, heap, 2-3-4, Trie, Huffman, Patricia, B),</li> <li>sets, priority queues,</li> <li>directed and undirected graphs (spanning trees, shortest and longest path)</li> </ul>
Literature	Skriptum

Course L0132: Objectoriented Programming, Algorithms and Data Structures		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Rolf-Rainer Grigat	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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<b>A</b>				
Courses				
Title	,	Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (large)	3 1	4 2
Module Responsible	* 			
Admission				
Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theo covered by the moduls Mathematik 1-3 is (Fourier series, Fourier transform, Laplace	expected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	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.			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific prob			
Autonomy	The students are able to acquire relevant control their level of knowledge during the clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engeneering: Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory	gram): Specialisation Process E gram): Specialisation Bioproces n program): Specialisation an program): Specialisation gram): Specialisation Biomedica ogram, 7 semester): Specialisation program, 7 semester): Specialisation gram, 7 semester): Specialisation	ingineering: is Engineerin Civil- and Mechanical al Engineerin tion Electric isation Com ation Proces on Bioproces	Compulsory ng: Compulso Enviroment Engineerin ng: Compulso al Engineerin nputer Scienc as Engineerin ss Engineerin
	Compulsory General Engineering Science (German pro Focus Biomechanics: Compulsory	gram, 7 semester): Specialisatio	on Mechanic	al Engineerir



	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



urse L0432: Signals a	nd Systems				
Тур	Lecture				
Hrs/wk					
СР					
	Independent Study Time 78, Study Time in Lecture 42				
	Prof. Gerhard Bauch				
Language	DE/EN SoSe				
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>				
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>				



Course L0433: Signals a	ourse L0433: Signals and Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Gerhard Bauch		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses								
Title Graph Theory and Optimiza	tion (L1	046)			<b>Typ</b> Lectu	ıre	Hrs/wk 2	<b>СР</b> 3
Graph Theory and Optimiza	tion (L1	047)			Recit	ation Section (small)	2	3
Module Responsible		Anusch Taraz						
Admission Requirements	None							
Recommended Previous Knowledge	•	Discrete Alg Mathematic		tures				
<b>Educational Objectives</b>	After ta	aking part suc	cessfully, st	udents have	e reached the	e following learning	results	
Professional Competence								
Knowledge	•	explain then	n using appr an discuss le nese connec	opriate exa ogical conr tions with th	mples. nections bet ne help of ex			-
Skills	<ul> <li>Students can model problems in Graph Theory and Optimization with the help of the concep studied in this course. Moreover, they are capable of solving them by applying establishe methods.</li> <li>Students are able to discover and verify further logical connections between the concep studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>							
Personal Competence								
Social Competence	•	common lar In doing so,	iguage. they can co	ommunicate	new concep	They are capable ots according to the o check and deepe	needs of th	neir cooperatin
Autonomy		can specify	open questic ve develope	ons precisel ed sufficient	y and know	anding of complex o where to get help in to be able to work f	solving the	m.
Workload in Hours	Indep	endent Study	Time 124, S	tudy Time in	n Lecture 56			
Credit points	6							
Examination	Writte	n exam						
Examination duration and scale	120 m	in						
Assignment for the	Gener Comp Comp	al Engineeri ulsory uter Science:	ng Science Core qualifi	(German p	program, 7	ialisation Computer semester): Special alisation Computer	isation Cor	nputer Science



 Following Curricula
 General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

 Computational Science and Engineering: Core qualification: Compulsory

 Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

 Technomathematics: Specialisation I. Mathematics: Elective Compulsory

Course L1046: Graph Theory and Optimization			
	Lecture		
Hrs/wk			
CP			
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Anusch Taraz		
Language			
Cycle			
Content	<ul> <li>Graphs, search algorithms for graphs, trees</li> <li>planar graphs</li> <li>shortest paths</li> <li>minimum spanning trees</li> <li>maximum flow and minimum cut</li> <li>theorems of Menger, König-Egervary, Hall</li> <li>NP-complete problems</li> <li>backtracking and heuristics</li> <li>linear programming</li> <li>duality</li> <li>integer linear programming</li> </ul>		
Literature	<ul> <li>M. Aigner: Diskrete Mathematik, Vieweg, 2004</li> <li>J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007</li> <li>A. Steger: Diskrete Strukturen (Band 1), Springer, 2001</li> <li>A. Taraz: Diskrete Mathematik, Birkhäuser, 2012</li> <li>V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009</li> <li>KH. Zimmermann: Diskrete Mathematik, BoD, 2006</li> </ul>		

Course L1047: Graph Theory and Optimization		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Anusch Taraz	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0727: Sto	ochastics			
Courses				
<b>Title</b> Stochastics (L0777) Stochastics (L0778)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Calculus</li> <li>Discrete algebraic structures (combinatorio</li> <li>Propositional logic</li> </ul>	cs)		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
	Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques.			
Skills	approximation techniques are good enough in va estimators and judge whether they are applicable	arious application context or reliable.	ts, i.e., stude	ents can derive
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their teams (i.e., teams from different study programs results appropriately (e.g. during exercise class).	•	•	• •
	- Students are capable of checking their understa specify open questions precisely and know where	to get help in solving ther	n.	own. They can
Autonomy	<ul> <li>Students can put their knowledge in relation to th</li> <li>Students have developed sufficient persistenc oriented manner on hard problems.</li> </ul>			ods in a goal-
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory			



Тур	Lecture
Hrs/wk	2
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	SoSe
	Foundations of probability theory
	<ul> <li>Definitions of probability, conditional probability</li> <li>Random variables, dependencies, independence assumptions,</li> <li>Marginal and joint probabilities</li> <li>Distributions and density functions</li> <li>Characteristics: expected values, variance, standard deviation, moments</li> </ul>
Content	<ul> <li>Practical representations for joint probabilities</li> <li>Bayessche Netzwerke</li> <li>Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen</li> <li>Stochastic processes</li> </ul>
	<ul> <li>Stationarity, ergodicity</li> <li>Correlations</li> <li>Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues</li> <li>Detection &amp; estimation</li> </ul>
	<ul> <li>Detectors</li> <li>Estimation rules and procedures</li> <li>Hypothesis and distribution tests</li> <li>Stochastic regression</li> </ul>
Literature	<ol> <li>Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008</li> <li>Stochastik für Informatiker, Dümbgen, L., Springer 2003</li> <li>Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 201</li> <li>Stochastik, Georgii, HO., deGruyter, 2009</li> <li>Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001</li> <li>Programmieren mit R, Ligges, U., Springer 2008</li> </ol>

Course L0778: Stochast	Course L0778: Stochastics		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Francisco Javier Hoecker-Escuti		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Title		Тур	Hrs/wk	CP
Automata Theory and Form Automata Theory and Form		Lecture Recitation Section (sma	2 II) 2	4 2
Module Responsible			., _	_
Admission				
Requirements	None			
	Participating students should be able to			
	- specify algorithms for simple data struc	tures (such as, e.g., arrays) to so	lve computatio	onal problems
Recommended Previous Knowledge			-	-
			-	
	- apply the knowledge and skills taught i	n the module Discrete Algebraic	Structures	
Educational Objectives	After taking part successfully, students ha	ave reached the following learni	ng results	
Professional				
Competence	Students can explain syntax, semantics	and desiring analyticate of an		
Knowledge	algebra. Students can describe which application problems are hard to represent with propositional logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and those formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily induce algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, automata, or grammars.			
	Students can apply propositional logic as well as predicate logic resolution to a given set of formula Students analyze application problems in order to derive propositional logic, predicate logic, or temporal logic formulas to represent them. They can evaluate which formalism is best suited for particular application problem, and they can demonstrate the application of algorithms for decisic problems to specific formulas. Students can also transform nondeterministic automata in deterministic ones, or derive grammars from automata and vice versa. They can show how parse work, and they can apply algorithms for the language emptiness problem in case of infinite words.			
Personal Competence				
Social Competence				
Autonomy Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale	90 min			
Assignment for the	General Engineering Science (German p General Engineering Science (German Elective Compulsory Computer Science: Core qualification: C	n program, 7 semester): Spec		



 Following Curricula
 General Engineering Science (English program): Specialisation Computer Science: Compulsory

 General Engineering Science (English program, 7 semester): Specialisation Computer Science:

 Elective Compulsory

 Computational Science and Engineering: Core qualification: Compulsory

 Technomathematics: Specialisation II. Informatics: Elective Compulsory

Түр	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Tobias Knopp
Language	EN
Cycle	
Content	<ol> <li>Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF</li> <li>Predicate logic, unification, predicate logic resolution</li> <li>Temporal Logics (LTL, CTL)</li> <li>Deterministic finite automata, definition and construction</li> <li>Regular languages, closure properties, word problem, string matching</li> <li>Nondeterministic automata:         <ul> <li>Rabin-Scott transformation of nondeterministic into deterministic automata</li> <li>Epsilon automata, minimization of automata,                 elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)</li> <li>Myhill-Nerode Theorem:</li> <li>Correctness of the minimization procedure, equivalence classes of strings induced                 automata</li> <li>Pumping Lemma for regular languages:                 provision of a tool which, in some cases, can be used to show that a finite automata                 principally cannot be expressive enough to solve a word problem for some given language</li> </ul> </li> <li>Regular expressions vs. finite automata:         <ul> <li>Equivalence of formalisms, systematic transformation of representations, reductions</li> <li>Pushdown automata and context-free grammars:                 Definition of pushdown automata, definition of context-free grammars, transformation of formalisms (fp                 pushdown automata</li> <li>Chomsky normal form</li> <li>CYK algorithm for deciding the word problem for context-free grammrs</li> </ul> </li> <li>Deterministic pushdown automata</li> <li>Deterministic pushdown automata:         <ul> <li>Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdot automata, compiler</li> <li>Regular grammars</li> <li>Cutosk: Turing machines and linear bounded automata vs general and context-sensi grammars</li></ul></li></ol>
Literature	<ol> <li>Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.</li> <li>Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006</li> <li>Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.</li> <li>Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007</li> </ol>



Course L0507: Automata	ourse L0507: Automata Theory and Formal Languages		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Tobias Knopp		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0803: En	nbedded Systems			
Courses				
Title Embedded Systems (L0805 Embedded Systems (L0806		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Computer Engineering			
Educational Objectives	After taking part successfully, students have reach	hed the following learning	results	
Professional Competence				
	Embedded systems can be defined as information processing systems embedded into enclosing products. This course teaches the foundations of such systems. In particular, it deals with an introduction into these systems (notions, common characteristics) and their specification languages (models of computation, hierarchical automata, specification of distributed systems, task graphs, specification of real-time applications, translations between different models).			
Knowledge	Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time capable communication hardware, embedded processors, memories, energy dissipation reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded systems using hardware/software co-design (hardware/software partitioning, high-level transformations o specifications, energy-efficient realizations, compilers for embedded processors) is covered.			
	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge in which areas of embedded system design specific risks exist.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	e or in a group and to prese	ent the result	ts accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points				
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory			



Τνρ	Lecture
Hrs/wk	
СР	
	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	EN
Cycle	SoSe
Content	<ul> <li>Introduction</li> <li>Specifications and Modeling</li> <li>Embedded/Cyber-Physical Systems Hardware</li> <li>System Software</li> <li>Evaluation and Validation</li> <li>Mapping of Applications to Execution Platforms</li> <li>Optimization</li> </ul>
Literature	<ul> <li>Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyb Physical Systems. 2<sup>nd</sup> Edition, Springer, 2012., Springer, 2012.</li> </ul>

Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0793: Se	minars Computer Science an	d Mathematics		
Courses				
Title Seminar Computational Mathematics/Computer Science (L0797) Seminar Computational Engineering Science (L0796) Seminar Engineering Mathematics/Computer Science (L1781)		<b>Typ</b> Seminar Seminar Seminar	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in Computer Science,	Mathematics, and eventually	y Engineering Scie	nce.
Educational Objectives	After taking part successfully, students h	ave reached the following le	earning results	
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a rudimentary field of Computer Science Mathematics, or Engineering Science.			
Skills	The students are able to elaborate self-reliantly a rudimentary subfield of Computer Science Mathematics, or Engineering Science.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Examination	Presentation			
Examination duration and scale	Presentation 20 min and discussion 5 m	in.		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory			

Course L0797: Seminar	Computational Mathematics/Computer Science
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Karl-Heinz Zimmermann, Dr. Jens-Peter Zemke
Language	DE/EN
Cycle	WiSe/SoSe
Content	<ul> <li>Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics or computer science are proposed by the organizer</li> <li>Active participation in discussions.</li> </ul>
Literature	Wird vom Seminarveranstalter bekanntgegeben.



Course L0796: Seminar	Computational Engineering Science
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Karl-Heinz Zimmermann
Language	DE/EN
Cycle	WiSe/SoSe
Content	<ul> <li>Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering science are proposed by the organizer</li> <li>Active participation in discussions.</li> </ul>
Literature	Wird vom Seminarveranstalter bekanntgegeben.

Course L1781: Seminar Engineering Mathematics/Computer Science		
Тур	Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Karl-Heinz Zimmermann, Dr. Jens-Peter Zemke	
Language	DE/EN	
Cycle	WiSe/SoSe	
Content	<ul> <li>Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering mathematics are proposed by the organizer</li> <li>Active participation in discussions.</li> </ul>	
Literature	Wird vom Seminarveranstalter bekanntgegeben.	



Module M0834: Co	omputernetworks and Intern	net Security		
Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Inte		Lecture	3	5
Computer Networks and Inte	ernet Security (L1099)	Recitation Section (small)	1	1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of Computer Science			
Educational Objectives	After taking part successfully, studen	ts have reached the following learning	results	
Professional				
Competence Knowledge	Students are able to explain importa	ant and common Internet protocols in lop networked systems in further studi		classify them, in
Skills	Students are able to analyse comn domains.	non Internet protocols and evaluate t	he use of th	nem in different
Personal Competence				
Social Competence				
Autonomy	Students can select relevant par independently learn and understand	ts out of high amount of professi it.	onal knowl	edge and can
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			



ourse L1098: Compute	r Networks and Internet Security
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann
Language	
Cycle	WiSe
	In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs. In the second part of the lecture an introduction to Internet security is given.
Content	<ul> <li>This class comprises:</li> <li>Application layer protocols (HTTP, FTP, DNS)</li> <li>Transport layer protocols (TCP, UDP)</li> <li>Network Layer (Internet Protocol, routing in the Internet)</li> <li>Data link layer with media access at the example of Ethernet</li> <li>Multimedia applications in the Internet</li> <li>Network management</li> <li>Internet security: IPSec</li> <li>Internet security: Firewalls</li> </ul>
Literature	<ul> <li>Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley</li> <li>Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage</li> <li>W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition</li> </ul>

ourse L1099: Computer Networks and Internet Security	
Recitation Section (small)	
1	
1	
Independent Study Time 16, Study Time in Lecture 14	
Prof. Andreas Timm-Giel, Prof. Dieter Gollmann	
EN	
WiSe	
See interlocking course	
See interlocking course	



Module M0731: Fu	nctional Programming			
Courses				
<b>Title</b> Functional Programming (L0 Functional Programming (L0 Functional Programming (L0	0625)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete mathematics at high-school level			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.			
Skills	Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.			
Personal Competence				
Social Competence	Students practice peer programming with v peer. They defend their programs orally. The		olems and s	olutions to their
Autonomy	In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") the mechanics of programming. In exercises, they develop solutions individually and independently, and receive feedback.			
Workload in Hours	Independent Study Time 96, Study Time in I	_ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
_	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			



Course L0624: Function	al Programming
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	<ul> <li>Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions</li> <li>Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions</li> <li>Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type</li> <li>Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps)</li> <li>Modules</li> <li>Interactive Programming</li> <li>Lazy Evaluation, Call-by-Value, Strictness</li> <li>Design Recipes</li> <li>Testing (axiom-based, invariant-based, against reference implementation)</li> <li>Reasoning about Programs (equation-based, inductive)</li> <li>Idioms of Functional Programming</li> <li>Haskell Syntax and Semantics</li> </ul>
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.

Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	<ul> <li>Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions</li> <li>Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions</li> <li>Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type</li> <li>Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps)</li> <li>Modules</li> <li>Interactive Programming</li> <li>Lazy Evaluation, Call-by-Value, Strictness</li> <li>Design Recipes</li> <li>Testing (axiom-based, invariant-based, against reference implementation)</li> <li>Reasoning about Programming</li> <li>Idioms of Functional Programming</li> <li>Haskell Syntax and Semantics</li> </ul>
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.



Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	<ul> <li>Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions</li> <li>Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions</li> <li>Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type</li> <li>Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps)</li> <li>Modules</li> <li>Interactive Programming</li> <li>Lazy Evaluation, Call-by-Value, Strictness</li> <li>Design Recipes</li> <li>Testing (axiom-based, invariant-based, against reference implementation)</li> <li>Reasoning about Programs (equation-based, inductive)</li> <li>Idioms of Functional Programming</li> <li>Haskell Syntax and Semantics</li> </ul>
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.



Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L	0417)	Lecture	2	3
Numerical Mathematics I (Li		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Student II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	s (german or english) <b>or</b> Ai	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	Students are able to			
Knowledge	<ul> <li>name numerical methods for interpolation, integration, least squares problems, eigenverse problems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computate and storage complexitx.</li> </ul>		-	
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem a solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>			
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>work together in heterogeneously comp and background knowledge), explain t practical aspects regarding the implement</li> </ul>	heoretical foundations an		
	Students are capable			
Autonomy	<ul> <li>to assess whether the supporting the individually or in a team,</li> <li>to assess their individual progess and, if</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points				
	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program General Engineering Science (German progr Biomechanics: Compulsory General Engineering Science (German progr Materials in Engineering Sciences: Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Comp	am): Specialisation Mech am): Specialisation Mech ): Specialisation Biomedica am, 7 semester): Specialisatio	anical Engi anical Engi al Engineeri isation Con	neering, Focu neering, Focu ng:Compulso uputer Scienc



	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
Assignment for the	Electrical Engineering: Core qualification: Elective Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Mathematics I		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell	
Language	DE/EN	
Cycle	WiSe	
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>	
Literature	<ul> <li>Stoer/Bulirsch: Numerische Mathematik 1, Springer</li> <li>Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer</li> </ul>	



Course L0418: Numerica	rse L0418: Numerical Mathematics I	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0791: Co	omputer Architecture			
Courses				
Title		Тур	Hrs/wk	СР
Computer Architecture (L07	,	Lecture	2	3
Computer Architecture (L07	94)	Project-/problem-based Learning	2	2
Computer Architecture (L18	64)	Recitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Computer Engineering"			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution machine instructions and for memory hierarchies.		eneral-purpose ional aspects o on the so-callec his context. The	
Skills	The students are able to describe the organization of processors. They know the different architectura principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly		Its accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.		this knowledge	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Written exam			
Examination duration and scale	190 minutes, contents of course and 4 attestations from the PBL "Computer architecture"			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory			



Course L0793: Compute	r Architecture
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>VHDL Basics</li> <li>Programming Models</li> <li>Realization of Elementary Data Types</li> <li>Dynamic Scheduling</li> <li>Branch Prediction</li> <li>Superscalar Machines</li> <li>Memory Hierarchies</li> </ul> The theoretical tutorials amplify the lecture's content by solving and discussing exercise sheets and thus serve as exam preparation. Practical aspects of computer architecture are taught in the FPGA-based PBL on computer architecture whose attendance is mandatory.
Literature	<ul> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> </ul>

Course L0794: Compute	urse L0794: Computer Architecture	
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof Herbert Werner			
Admission				
Requirements				
Recommended Previous Knowledge	Representation of signals and systems i	n time and frequency domain, Lap	ace transfor	m
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequent response</li> <li>They can explain issues arising when controllers designed in continuous time domain a implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain a vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus a frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to	jointly solve technical problems, a	and experim	entally valida
Autonomy	Students can obtain information from provided sources (lecture notes, software documentati 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 Tim	e in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	n program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	Computeron
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory			

_ 1	
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems   Linear systems, differential equations and transfer functions  First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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  Root locus techniques Root locus techniques Bode diagram Minimum and non-minimum phase systems Styquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Similar delay systems Root locus and frequency response of time delay systems Somith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Module M0562: Co	omputability and Complexity Theory			
Courses				
Title		Тур	Hrs/wk	СР
Computability and Complexi		Lecture	2	3
Computability and Complexit	ty Theory (L0167)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete Algebraic Structures, Automata Theory,	Logic, and Formal Langua	ge Theory.	
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	The students known the important machine models of computability, the class of partial recursive functions, universal computability, Gödel numbering of computations, the theorems of Kleene, Rice and Rice-Shapiro, the concept of decidable and undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence systems, Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.			
Personal Competence				
	Students are able to solve specific problems alone or in a group and to present the results accordingly			
Autonomy	Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination				
Examination duration and scale	20 min			
Assignment for the Following Curricula	General Engineering Science (German progra Elective Compulsory Computer Science: Core qualification: Compulso General Engineering Science (English progra Elective Compulsory Computational Science and Engineering: Specia Computational Science and Engineering: Specia Technomathematics: Specialisation II. Informatics Technomathematics: Core qualification: Elective	ry m, 7 semester): Speciali lisation Computer Science lisation Computer Science s: Elective Compulsory	sation Com	nputer Science ompulsory

Course L0166: Computability and Complexity Theory		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Karl-Heinz Zimmermann	
Language	DE/EN	
Cycle	SoSe	
Content		
Literature		



Course L0167: Computa	course L0167: Computability and Complexity Theory		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature			



Module M0732: So	ftware Engineering			
Courses				
Title Software Engineering (L062 Software Engineering (L062		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>СР</b> 3 3
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Automata theory and formal languages</li> <li>Procedural programming or Functional p</li> <li>Object-oriented programming, algorithms</li> </ul>			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write test cases for different test strategies and devise specifications or models using different notations, and critique both. They explain simple design patterns and the major activities in requirements analysis, maintenance, and project planning.			
Skills	For a given task in the software life cycle, stud appropriate method. They choose the proper a realistic systems, assess the quality of the test modify non-executable artifacts. They integrate of	approach for quality assura s, and find errors at differ	ance. They ent levels.	design tests for They apply and
Personal Competence				
	Students practice peer programming. They e communicate in English.	xplain problems and sol	utions to th	neir peer. They
Autonomy	Using on-line quizzes and accompanying mate knowledge continuously and adjust it appropr additional feedback.			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German progr Elective Compulsory Computer Science: Core qualification: Compulsor General Engineering Science (English progra Elective Compulsory Computational Science and Engineering: Specia Computational Science and Engineering: Specia Technomathematics: Specialisation II. Information	ory am, 7 semester): Speciali alisation Computer Science alisation Computer Science	sation Con e: Elective C	nputer Science: ompulsory



Course L0627: Software	Engineering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	SoSe
Content	<ul> <li>Software Life Cycle Models (Waterfall, V-Model, Evolutionary Models, IncrementalModels, Iterative Models, Agile Processes)</li> <li>Requirements (Elicitation Techniques, UML Use Case Diagrams, Functional and Non-Functional Requirements)</li> <li>Specification (Finite State Machines, Extended FSMs, Petri Nets, Behavioral UML Diagrams, Data Modeling)</li> <li>Design (Design Concepts, Modules, (Agile) Design Principles)</li> <li>Object-Oriented Analysis and Design (Object Identification, UML Interaction Diagrams, UML Class Diagrams, Architectural Patterns)</li> <li>Testing (Blackbox Testing, Whitebox Testing, Control-Flow Testing, Data-Flow Testing, Testing in the Large)</li> <li>Maintenance and Evolution (Regression Testing, Reverse Engineering, Reengineering)</li> <li>Project Management (Blackbox Estimation Techniques, Whitebox Estimation Techniques, Project Plans, Gantt Charts, PERT Charts)</li> </ul>
Literature	Kassem A. Saleh, Software Engineering, J. Ross Publishing 2009.

Course L0628: Software	ourse L0628: Software Engineering	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Schupp	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0829: Fo	undations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Management	(L0880)	Lecture	3	3
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most import aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and source supply chain management, organization and human ressource management, informat management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathematic Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			e most importa t and sourcin ent, informatic situations und
Skills	Students are able to analyse business uni strategies etc.) and to carry out an Entrepre analyse Management goals and str analyse organisational and staff stru apply methods for decision making analyse production and procurement analyse and apply basic methods of select and apply basic methods from apply basic methods from accounting	neurship project in a team. In p ucture them appropriately uctures of companies under multiple objectives, unde nt systems and Business inform f marketing n mathematical finance to prede	articular, the r uncertainty ation system	y are able to y and under ris is
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the l report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their f</li> </ul>	ecture to an entrepreneurship	project and v	write a cohere
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the</li> <li>to write a report on their project.</li> </ul>	team themselves		
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points				
Examination	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor
	General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Computer Scien	ce:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineeri Compulsory	ng:
General Engineering Science (English program, 7 semester): Specialisation Civil Engineeri Compulsory	ng:
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromer Engineering: Compulsory	ntal
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Mechatronics: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Biomechanics: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Aircraft Systems Engineering: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Materials in Engineering Sciences: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Theoretical Mechanical Engineering: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Product Development and Production: Compulsory	ng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Energy Systems: Compulsory	ng,
Computational Science and Engineering: Core qualification: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	



Tvn	Lecture
Hrs/wk	
CP	
	 Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kath Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>



Course L0882: Project Entrepreneurship	
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M1269: La	b Cyber-Physical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Lab Cyber-Physical System	s (L1740)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Embedded Systems"			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence	Cyber-Physical Systems (CPS) are tightly inte	egrated with their surrounding	a environme	ent, via sensors
	A/D and D/A converters, and actors. Due to sensors, processors and actors are comm specification approaches for CPS - in contrast	o their particular application on. Accordingly, there is a	n areas, hig 1 large vari	hly specialized ety of different
Knowledge	Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation, hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab's experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors.			
Skills	After successful attendance of the lab, studen interdependencies between a CPS and its sur interacts with the environment via sensors, actors. The lab enables students to compare r limitations, and to decide which technique to techniques to practical problems. They o development, in industry-relevant specification	rounding processes which s A/D converters, digital proce nodelling approaches, to eva use for a concrete task. They btain first experiences in	tem from the essors, D/A aluate their will be able hardware-re	e fact that a CPS converters and advantages and to apply these elated software
Personal Competence				
Social Competence	Students are able to solve similar problems al	one or in a group and to pres	ent the resu	Its accordingly.
Autonomy	Students are able to acquire new knowledge with other classes.	from specific literature and t	o associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Execution and documentation of all lab experi	ments		
	General Engineering Science (German pro Elective Compulsory Computer Science: Specialisation Computer a General Engineering Science (English prog Elective Compulsory Computational Science and Engineering: Spe Computational Science and Engineering: Spe Compulsory Mechatronics: Specialisation Intelligent Syster Mechatronics: Specialisation System Design: Mechatronics: Technical Complementary Cou	and Software Engineering: El gram, 7 semester): Special cialisation Computer Science cialisation Mathematics & Er ns and Robotics: Elective Co Elective Compulsory	ective Comp isation Con e: Elective C igineering S	oulsory nputer Science ompulsory



Course L1740: Lab Cybe	er-Physical Systems
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Experiment 1: Programming in NXC</li> <li>Experiment 2: Programming the Robot in Matlab/Simulink</li> <li>Experiment 3: Programming the Robot in LabVIEW</li> </ul>
Literature	<ul> <li>Peter Marwedel. Embedded System Design - Embedded System Foundations of Cyber- Physical Systems. 2<sup>nd</sup> Edition, Springer, 2012.</li> <li>Begleitende Foliensätze</li> </ul>



Module M0971: Op	erating Systems			
Courses				
<b>Title</b> Operating Systems (L1153) Operating Systems (L1154)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	СР 3 3
Module Responsible	Prof. Volker Turau			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Object-oriented programming, algorithms,</li> <li>Procedural programming</li> <li>Experience in using tools related to opera</li> <li>Experience in using C-libraries</li> </ul>		ors, linkers, d	compilers
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms.			
Skills	Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program) General Engineering Science (German progra Elective Compulsory Computer Science: Core qualification: Compulso General Engineering Science (English program): General Engineering Science (English progra Elective Compulsory Computational Science and Engineering: Specia Computational Science and Engineering: Specia Technomathematics: Specialisation II. Informatics	m, 7 semester): Speciali ry Specialisation Computer m, 7 semester): Speciali lisation Computer Science	sation Com Science: Co sation Com : Elective C	nputer Science ompulsory nputer Science ompulsory



Course L1153: Operating	Course L1153: Operating Systems	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Volker Turau	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Architectures for Operating Systems</li> <li>Processes</li> <li>Concurrency</li> <li>Deadlocks</li> <li>Memory organization</li> <li>Scheduling</li> <li>File systems</li> </ul>	
Literature	<ol> <li>Operating Systems, William Stallings, Pearson International Edition</li> <li>Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium</li> </ol>	

<b>T</b>	
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Volker Turau
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title Mathematical Statistics (L13 Mathematical Statistics (L13		<b>Typ</b> Lecture Recitation Section (sr	Hrs/wk 3 nall) 1	<b>CP</b> 4 2
				2
Module Responsible Admission	Prof. Natalie Neumeyer			
Requirements	None			
Recommended	Mathematical Stochastics			
Draviaua Knowladga	Measure Theory and Stochastics			
	After taking part successfully, students ha	ave reached the following lear	ning results	
Professional Competence				
Knowledge	<ul> <li>Students can describe basic con Maximum-Likelihood methods for optimal tests for parametric prob application to estimation and to domains and test families. They a</li> <li>Students can discuss logical co illustrating these connections with</li> <li>They know proof strategies and car</li> </ul>	or construction of estimators, ability distributions, sufficient est problems, tests in norm re able to explain them using prinections between these content the sector the help of examples.	, optimal unfals acy and comple al distribution appropriate exa	sified estimato teness and the and confiden amples.
Skills	<ul> <li>Students can model problems in in this course. Moreover, they are</li> <li>Students are able to discover a studied in the course.</li> <li>For a given problem, the students to critically evaluate the results.</li> </ul>	capable of solving them by a nd verify further logical con	pplying establis nections betwe	hed methods. en the concep
Personal Competence				
Social Competence	<ul> <li>Students are able to work toget common language.</li> <li>In doing so, they can communica partners. Moreover, they can desi peers.</li> </ul>	te new concepts according to	o the needs of t	heir cooperati
Autonomy	<ul> <li>Students are capable of checking can specify open questions precis</li> <li>Students have developed sufficie oriented manner on hard problem</li> </ul>	sely and know where to get he nt persistence to be able to w	elp in solving the	əm.
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 minutes			



Assignment for the Following Curricula Elective Computer Science: Specialisation Computational Mathematics: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory

Course L1339: Mathema	tical Statistics
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Substitution and Maximum-Likelihood methods for construction of estimators</li> <li>Optimal unfalsified estimators</li> <li>Optimal tests for parametric probability distributions (Neymann-Pearson theory)</li> <li>Sufficiency and completeness and their application to estimation and test problems</li> <li>Tests in normal distribution (e.g. Student's test)</li> <li>Confidence domains and test families</li> </ul>
Literature	<ul> <li>V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley.</li> <li>L. Wasserman (2010). All of statistics : A concise course in statistical inference. Springer.</li> <li>H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner.</li> </ul>

Course L1340: Mathematical Statistics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



## **Specialization Mechanical Engineering**

The educational goal of this Bachelor's program is to develop the skills to select and link fundamental methods and procedures in order to solve technical problems in the field of General Engineering science, especially in the selected subject area of specialisation.

Graduates have:

1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.

2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.

3) In-depth knowledge in Engineering applications, especially in the selected subject area of specialisation (product development and manufacturing, material science, aircrafts, energy Engineering, mechatronics, medical engineering, theoretical mechanical engineering). They have in particular the necessary methodological knowledge and its application to engineering problems, taking into account technical specifications and economic and social parameters.

4) The ability to work scientifically and to expand their specialized knowledge independently.

Graduates are able to work responsibly and competently as mechanical engineers, especially in occupations related to the selected subject area of specialisation.

## Module M0598: Mechanical Engineering: Design

Courses

Courses			
Title	Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD (L0268)	Lecture	2	1
Mechanical Design Project I (L0695)	Practical Course	3	2
Mechanical Design Project II (L0592)	Practical Course	3	2
Team Project Design Methodology (L0267)	Project-/problem-based Learning	2	1

Module Responsible	
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,</li> <li>describe basics of 3D CAD,</li> <li>explain basics methods of engineering designing.</li> </ul>
Skills	<ul> <li>After passing the module, students are able to:</li> <li>independently create sketches, technical drawings and documentations e.g. using 3D CAD,</li> <li>design components based on design guidelines autonomously,</li> <li>dimension (calculate) used components,</li> <li>use methods to design and solve engineering design tasks systamtically and solution-oriented</li> <li>apply creativity techniques in teams.</li> </ul>
Personal Competence	After passing the module, students are able to:
	<ul> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> </ul>



Social Competence Autonomy	<ul> <li>moderate the use of scientific methods,</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course.</li> <li>Students are able</li> <li>to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),</li> <li>To solve engineering design tasks systematically.</li> </ul>
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140
Credit points	6
Examination	Written exam
Examination duration and scale	180
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory 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 Energy and Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system         <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, P. Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, I Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0695: Mechanical Design Project I		
Тур	Practical Course	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>	
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>	

Course L0592: Mechanical Design Project II		
Тур	Practical Course	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Generation of sketches for functions and sub-functions</li> <li>Approximately calculation of shafts</li> <li>Dimension of bearings, screw connections and weld</li> <li>Generation of engineering drawings (assembly drawings, manufacturing drawing)</li> </ul>	
Literature	<ul> <li>Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.</li> <li>Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.</li> <li>Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.</li> <li>Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.</li> </ul>	



Course L0267: Team Pro	oject Design Methodology		
Тур	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> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Module M0933: Fu	ndamentals of Materials Science			
-				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S		Lecture	2	2
	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
Composites) (L0506) Physical and Chemical Basi	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and car 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 fo 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.			
Skills	The students are able to trace materials phenom laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosid solidification, precipitation, or melting. The stud conditions and the materials microstructure, and t the material's behavior.	to mechanical properties on resistance, and to pha ents can explain the rel	such as str se transform ation betwe	ength, ductilit nations such a en processin
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture	84		
Credit points		, 04		
	Written exam			
Examination duration				
and scale	180 min			
	General Engineering Science (German prog	ram): Specialisation E	inergy and	Enviroment
	Engineering: Compulsory			
	General Engineering Science (German pro Compulsory	gram): Specialisation	Mechanical	Engineerin
	General Engineering Science (German program):	Specialisation Biomedica	l Engineerir	ig: Compulso
	General Engineering Science (German program): General Engineering Science (German program, 7 Compulsory	Specialisation Naval Arch	nitecture: Co	mpulsory
	General Engineering Science (German program,	7 semester): Specialisatic	on Biomedica	al Engineering
	Compulsory General Engineering Science (German progran Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		pecialisation	Energy an



Assignment for the Following Curricula	Engineering, Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L1085: Fundamentals of Materials Science I		
Тур	Lecture	
Hrs/wk	2	
СР	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	

Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	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	

1



Тур	Lecture	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Stefan Müller	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Motivation: "Atoms in Mechanical Engineering?"</li> <li>Basics: Force and Energy</li> <li>The electromagnetic Interaction <ul> <li>"Detour": Mathematics (complex e-funktion etc.)</li> </ul> </li> <li>The atom: Bohr's model of the atom</li> <li>Chemical bounds</li> <li>The multi part problem: Solutions and strategies</li> <li>Descriptions of using statistical thermodynamics</li> <li>Elastic theory of atoms</li> <li>Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)</li> </ul>	
Literature	<ul> <li>Für den Elektromagnetismus:</li> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> <li>Für die Atomphysik: <ul> <li>Haken, Wolf: "Atom- und Quantenphysik", Springer</li> </ul> </li> <li>Für die Materialphysik und Elastizität: <ul> <li>Hornbogen, Warlimont: "Metallkunde", Springer</li> </ul> </li> </ul>	



Courses			
Title	Тур	Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)	Lecture Recitation Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung		
Admission Requirements	None		
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics and	d thermodyn	amics.
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineerin and physics of fluids. Students can scientifically outline the rationale of flow physics usin mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices.		
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level.		
Personal Competence			
Social Competence	The students are able to discuss problems and jointly develop solution strat	egies.	
Autonomy	The students are able to develop solution strategies for complex problems analyse results.	self-consiste	ent and crtica
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Examination	Written exam		
Examination duration and scale	180 min		
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory 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 Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory Architecture: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory		



## Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0454: Fluid Med	chanics		
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Thomas Rung		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Overview</li> <li>Physical/mathematical modelling</li> <li>Special phenomena</li> <li>Basic equations of fluid dynamics</li> <li>The turbulence problem</li> <li>One dimensional theory for inkompressibel flows</li> <li>One dimensional theory for kompressibel flows</li> <li>Flow over contours without friction</li> <li>Flow over contours with friction</li> <li>Flow through channels</li> <li>Simplified equations for three dimensional flow</li> <li>Special aspects of the numerical solution for complex flows</li> </ul>		
Literature	<ul> <li>Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006</li> <li>Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004</li> </ul>		

Course L0455: Fluid Mechanics		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0960: N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Mec	hanics,	Multibody
o yotomo,			
Courses			
Title		Hrs/wk	СР
(L1137)		3	3
(L1130)		2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large)	1	1
Module Responsible			
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III		
Educational Objectives	After taking part successfully, students have reached the following learning re	esults	
Professional			
Competence			
Knowledge	<ul> <li>The students can</li> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>		
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation and apply it to the context of their own problems;</li> <li>apply basic methods to engineering problems;</li> <li>estimate the reach and boundaries of the methods and extend them to be applicable to wide problem sets.</li> </ul>		
Personal Competence			
Social Competence	The students converting evenue and support each other to supreme difficulties		
	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		
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the		Engineerin itecture: Cor Mechanica Biomedica ation Nava Engineering Engineering tecture: Con	npulsory Il Engineerin Il Engineerin I Architectur g: Compulso g: Compulsor npulsory
Following Curricula			2



Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Core qualification: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
 Compulsory

Тур	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	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
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) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1139: Mechanic	urse L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Robert Seifried		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Measurement Technology for	nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118)	<b>Typ</b> Practical Course Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Dr. Sven Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).			
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-		
	They can describe important methods of o Chromatography)	chemical Analysis (Gas Se	ensors, Spe	ctroscopy, G
Skills	Students can select suitable measuring measurement devices in practice. The students are able to orally explain issue solution approaches as well as place the issue	es in the subject area of me	asurement	technology a
Personal Competence	Students can arrive at work results in groups a	nd document them in a comr	non report.	
Social Competence			·	
Autonomy	Students are able to familiarize themselves wit	th new measurement technol	ogies.	
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points				
Examination Examination duration and scale	105 minutes			
	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra	program): Specialisation m): Specialisation Biomedica m): Specialisation Process E program, 7 semester): Sp m, 7 semester): Specialisation am, 7 semester): Specialisation ram, 7 semester): Specialisation	Mechanica al Engineeri ingineering: becialisatior on Mechanic on Biomedic	I Engineerin ng: Compulso Compulsory Energy a cal Engineerin cal Engineerin
	Energy and Environmental Engineering: Core	au alification O and I and		



Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Process Engineering: Core qualification: Compulsory



Course L1119: Practical	Course: Measurement and Control Systems
	Practical Course
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	DE
	 WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



	ment Technology for Mechanical and Process Engineers	
	Lecture	
Hrs/wk CP		
	Independent Study Time 62, Study Time in Lecture 28	
	Dr. Sven Krause	
Language	DE	
Cycle		
	1 Fundamentals	
	1.1 Quantities and Units	
	1.2 Uncertainty	
	1.3 Calibration	
	1.4 Static and Dynamic Properties of Sensors and Systems	
	2 Measurement of Electrical Quantities	
	2.1 Current and Voltage	
	2.2 Impedance	
	2.3 Amplification	
	2.4 Oscilloscope	
	2.5 Analog-to-Digital Conversion	
Content	2.6 Data Transmission	
Content	3 Measurement of Nonelectric Quantities	
	3.1 Temperature	
	3.2 Length, Displacement, Angle	
	3.3 Strain, Force, Pressure	
	3.4 Flow	
	3.5 Time, Frequency	
	4 Chemical Analysis	
	4.1 Gas Sensors	
	4.2 Spectroscopy	
	4.3 Gas Chromatography	
	At the end of each lecture students present single measuring techniques and results orally in front the class.	
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.	
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 97 3486217940.	



Course L1118: Measure	rse L1118: Measurement Technology for Mechanical and Process Engineers		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Sven Krause		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L0925) Quality Management (L0926)		Lecture Lecture	2 2	3 3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, st	udents have reached the following	learning results	
Professional Competence				
Knowledge	Students are able to explain the contents of the lecture of the module.			
Skills	Students are able to apply the r	nethods and models in the module	to industrial problem	ıs.
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, S	tudy Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering: Elect Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Elect Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Elective Compulsory			



Course L0925: Production	on Process Organization		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Hermann Lödding		
Language	EN		
Cycle	SoSe		
Content	<ul> <li>(A) Introduction</li> <li>(B) Product planning</li> <li>(C) Process planning</li> <li>(D) Procurement</li> <li>(E) Manufacturing</li> <li>(F) Production planning and control (PPC)</li> <li>(G) Distribution</li> <li>(H) Cooperation</li> </ul>		
Literature	Wiendahl, HP.: Betriebsorganisation für Ingenieure Vorlesungsskript		

Course L0926: Quality N	lanagement
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
Content	<ul> <li>Definition and Relevance of Quality</li> <li>Continuous Quality Improvement</li> <li>Quality Management in Product Development</li> <li>Quality Management in Production Processes</li> <li>Design of Experiments</li> </ul>
Literature	<ul> <li>Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002</li> <li>Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001</li> <li>Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008</li> <li>Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009</li> </ul>



Courses				
Fitle		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Thanh Trung Do			
Admission				
Requirements	Nono			
Recommended	Basics of mathematics, in particular complexe	e numbers, integrals, differentia	als	
	Basics of electrical engineering and mechani	cal engineering		
	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Competence	Students can to draw and explain the basic p	rinciples of electric and magn	atic fields	
		-		
Knowledge	They can describe the function of the s corresponding equations and characteristic			•
Nilowicage	major parameters of the energy efficiency of		-	
	engine.			
	Students arw able to calculate two-dimensior	al alastria and magnetic fields	in particula	r forromogn
	circuits with air gap. For this they apply the us	-		-
		-		
Skills	They can calulate the operational performanc and selected quantities and characteristic			
		ourves. They upply the usu		
	graphical methods.		a oquitaio	
	graphical methods.			
	graphical methods.			
Personal Competence				
Personal Competence Social Competence				
-	none Students are able independently to calculate		for applica	tions. They a
Social Competence	none Students are able independently to calculate able to analyse independently the operationa	I performance of electric mach	s for applica	tions. They
-	none Students are able independently to calculate able to analyse independently the operationa	I performance of electric mach	s for applica	tions. They a
Social Competence	none Students are able independently to calculate able to analyse independently the operationa	I performance of electric mach	s for applica	tions. They a
Social Competence Autonomy	none Students are able independently to calculate able to analyse independently the operationa	Il performance of electric mach Juantities and characteristic cu	s for applica	tions. They a
Social Competence Autonomy	none Students are able independently to calculate able to analyse independently the operationa data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L	Il performance of electric mach Juantities and characteristic cu	s for applica	tions. They a
Social Competence Autonomy Workload in Hours Credit points	none Students are able independently to calculate able to analyse independently the operationa data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L	Il performance of electric mach Juantities and characteristic cu	s for applica	tions. They a
Social Competence Autonomy Workload in Hours Credit points	none Students are able independently to calculate able to analyse independently the operationa data and theycan calculate thereof selected op Independent Study Time 110, Study Time in L 6 Written exam	Il performance of electric mach Juantities and characteristic cu	s for applica	tions. They a
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operationa data and theycan calculate thereof selected op Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten	Il performance of electric mach juantities and characteristic cu .ecture 70	for applica nines from th rves.	tions. They e characters
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected op Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German	Il performance of electric mach juantities and characteristic cu .ecture 70	for applica nines from th rves.	tions. They e characters
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E	s for applica hines from th rves.	tions. They e characters Enviromer
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro-	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E	s for applica hines from th rves.	tions. They e characters Enviromer
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan	for applica nines from th rves.	tions. They e characters Enviromer eering: Elect
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro- Compulsory General Engineering Science (German Enviromental Engineering: Compulsory	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp	for applications from the rves.	tions. They a e characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected q Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro- Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German pro-	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp	for applications from the rves.	tions. They a e characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro- Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering Science (German progr Elective Compulsory	Il performance of electric mach juantities and characteristic cu .ecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisatic	for applications from the rves.	tions. They a e characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected q Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro- Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German pro-	Il performance of electric mach juantities and characteristic cu ecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisatic	for applications from the rves.	tions. They a e characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination Examination and scale	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering: Core qualification: Ele Energy and Environmental Engineering: Core General Engineering Science (English	Il performance of electric mach juantities and characteristic cu .ecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisatic ective Compulsory e qualification: Compulsory	for applications from the rves.	tions. They e characters Enviromer eering: Elect Energy a al Engineeri
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German proor Compulsory General Engineering Science (German proor Compulsory General Engineering Science (German proor Enviromental Engineering: Compulsory General Engineering Science (German proor Elective Compulsory Electrical Engineering: Core qualification: Ele Energy and Environmental Engineering: Core General Engineering Science (English Engineering: Compulsory	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisatio ective Compulsory e qualification: Compulsory program): Specialisation E	for applications from the rves.	tions. They e characters Enviromer eering: Elect Energy a al Engineeri Enviromer
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering: Compulsory General Engineering: Core qualification: Ele Energy and Environmental Engineering: Core General Engineering Science (English Engineering: Compulsory General Engineering Science (English Engineering: Compulsory General Engineering Science (English prog	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisatio ective Compulsory e qualification: Compulsory program): Specialisation E	for applications from the rves.	tions. They e characters Enviromer eering: Elect Energy a al Engineeri Enviromer
Social Competence Autonomy Workload in Hours Credit points Examination Examination and scale	none Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected of Independent Study Time 110, Study Time in L 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German proor Compulsory General Engineering Science (German proor Compulsory General Engineering Science (German proor Encities Compulsory General Engineering: Compulsory General Engineering: Compulsory General Engineering: Core qualification: Ele Energy and Environmental Engineering: Core General Engineering Science (English Engineering: Compulsory	Il performance of electric mach Juantities and characteristic cu Lecture 70 program): Specialisation E gram): Specialisation Mechan program, 7 semester): Sp am, 7 semester): Specialisation ective Compulsory e qualification: Compulsory program): Specialisation E gram): Specialisation Mechan	a for applications from the rines from the rves.	tions. They e characters Enviromer eering: Elect Energy a al Engineeri Enviromer eering: Elect



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Mechanical Engineering: Core qualification: Elective Compulsory Mechatronics: Core qualification: Compulsory

Course L0293: Electrica	I Machines
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Trung Do Thanh
Language	DE
Cycle	SoSe
Content	Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force Magnetic field: force, flux line, Ampere's law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands'diagram), torque vs. speed characteristics, rotor layout (Squirrelcage vs. sliprings), Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short- cuircuit characteristics, vector diagrams, motor and generator operation drives with variable speed, inverter fed operation, special drives, step motors,
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"



Course L0294: Electrica	I Machines
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Trung Do Thanh, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	Exercises to the application of electric and magnetic fields. Excercises to the operational performance of eletric machines.
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"



Module M0934: Ad	Ivanced Materials			
Courses				
Title Advanced Materials Charac Advanced Materials Design Advanced Materials Design	(L1091)	<b>Typ</b> Lecture Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Patrick Huber			
Admission Requirements				
Recommended Previous Knowledge	Fundamentals of Materials Science (I and II)			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	The students will be able to explain the properti in technology, in particular metallic, ceramic, po (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence				
Social Competence	The students are able to present solutions to spe	cialists and to develop ide	as further.	
Autonomy	<ul> <li>The students are able to</li> <li>assess their own strengths and weaknes</li> <li>define tasks independently.</li> </ul>	ses.		
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ire 84		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English program Elective Compulsory Mechanical Engineering: Core qualification: Ele	, 7 semester): Specialisatic m): Specialisation Mechai , 7 semester): Specialisatic	on Mechanic	cal Engineering: eering: Elective



Course L1087: Advanced Materials Characterization		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Patrick Huber	
Language	DE	
Cycle	SoSe	
Content		
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011). William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).	

Course L1091: Advance	Course L1091: Advanced Materials Design		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature	Vorlesungsunterlagen		

Course L1092: Advanced Materials Design		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



## **Focus Biomechanics**

Students with the emphasis Biomechanics get in addition to their core engineering skills, a basic understanding of the medical field focusing on fracture healing and implants. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area.

Courses						
Title				Typ	Hrs/wk	СР
Advanced Mechanical Engir	peering Design	11 (1 0264)		<b>Typ</b> Lecture	2	2 2
Advanced Mechanical Engir	0 0	,		Recitation Section (large)	2	1
Advanced Mechanical Engir				Lecture	2	2
Advanced Mechanical Engir				Recitation Section (large)	2	1
Module Responsible	Prof. Dieter ł	Krause				
Admission Requirements	None					
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Engineering Design</li> <li>Mechanics</li> <li>Fundamentals of Materials Science</li> <li>Production Engineering</li> </ul>					
<b>Educational Objectives</b>	After taking p	part successfully, stud	dents have reach	ed the following learning	results	
Professional Competence						
	After passing	g the module, studen	ts are able to:			
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic element of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>					
Skills	<ul> <li>accord</li> <li>trans</li> <li>skills</li> <li>recog</li> </ul>	fer knowledge learn ),	calculations of c ed in the modul echnical drawing	overed machine element e to new requirements a s and schematic sketches	and tasks (p	problem solvi
Personal Competence						
Social Competence	<ul> <li>Stude meth</li> </ul>		scuss technical	information in the lectu	re supporte	d by activati
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>					
Workload in Hours	Independent	t Study Time 68, Stud	ly Time in Lecture	e 112		
Credit points	6					
Examination	Written exam	1				
Examination duration and scale	120		_			
	Energy Syste	ems: Compulsory		m): Specialisation Mech m): Specialisation Mech	-	

	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the	Focus Energy Systems: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
i onoring ourrioula	Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory



urse L0264: Advance	d Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	
	Advanced Mechanical Engineering Design I & II
Content	Lecture  • Fundamentals of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Seals  • Clutches & brakes  • Gear drives  • Epicyclic gears  • Crank drives  • Sliding bearings  • Elements of fluidics  Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Calculation methods of the following machine elements:  • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of the following machine elements: • Calculation methods of t
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springe Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuell Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



ourse L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II  Lecture
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0263: Advance	ourse L0263: Advanced Mechanical Engineering Design I		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1277: ME	ED I: Introduction to Anatomy	/		
Courses				
Title Introduction to Anatomy (L0)	384)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Udo Schumacher			
Admission Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students	have reached the following lea	arning results	
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeletal system. The students can describe the basic macroscopy and microscopy of those systems.			
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.			
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquire the relevant knowledge themselves.			
Workload in Hours	Independent Study Time 62, Study Tim	e in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory			



Course L0384: Introduct	ion to Anatomy			
Түр	Lecture			
Hrs/wk				
CP				
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Tobias Lange			
Language				
Cycle	SoSe			
Content	General Anatomy1 st week:The Eucaryote Cell2 <sup>nd</sup> week:The Tissues3 <sup>rd</sup> week:Cell Cycle, Basics in Development4 <sup>th</sup> week:Musculoskeletal System5 <sup>th</sup> week:Cardiovascular System6 <sup>th</sup> week:Respiratory System7 <sup>th</sup> week:Genito-urinary System8 <sup>th</sup> week:Immune system9 <sup>th</sup> week:Digestive System I10 <sup>th</sup> week:Digestive System II11 <sup>th</sup> week:Endocrine System12 <sup>th</sup> week:Nervous System			
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012			

Γ



	<b>Hrs/wk</b> 3	<b>CP</b> 4	
Section (large)	1	2	
None			
The modul is an introduction to the theory of signals and systems. Good knowledge in maths a covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation (Fourier series, Fourier transform, Laplace transform) is useful but not required.			
lowing learning	results		
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.			
The students are able to describe and analyse deterministic signals and linear time-invariant system 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 asses the impact of LTI systems on the signal properties in time and frequency domain.			
The students can jointly solve specific problems.			
n appropriate lit by solving tutoria			
ation Computer ation Process Er ation Bioprocess Specialisation Specialisation ation Biomedica ter): Specialisat ester): Specialisatio er): Specialisatio er): Specialisatio	ngineering: s Engineeri Civil- and Mechanica al Engineeri tion Electric sation Con ation Proces on Bioproce	Compulsory ng: Compulso Enviroment I Engineerin ng: Compulso cal Engineerin ss Engineerin ss Engineerin cal Engineerin	
er	): Specialisatic	): Specialisation Mechanic	



	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0432: Signals a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	4
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



ourse L0433: Signals and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses					
Title	d Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements	None				
Recommended Previous Knowledge	None				
Educational Objectives	After taking part successfully, students	have reached the following l	earning results		
Professional Competence					
	The students can explain treatment p surgery, internal medicine).				
	The students can describe the paties care.	nts' passage from their initia	al admittance throu	gh to follow-	
	Diagnostics				
Knowledge	The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as sectional imaging techniques (CT, MRT, US).				
	The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well a the technical basis for those techniques.				
	The students can choose the right tre needs.	atment method depending o	on the patient's clini	cal history a	
	The student can explain the influence	of technical errors on the ima	ging techniques.		
	The student can draw the right conc protocol.	lusions based on the image	es' diagnostic findin	gs or the err	
	<b>Therapy</b> The students can distinguish curative conclusion.	and palliative situations ar	nd motivate why the	ey came to th	
	The students can develop adequate th	erapy concepts and relate it t	to the radiation biolo	gical aspects	
	The students can use the therapeutic p	principle (effects vs adverse e	effects)		
	The students can distinguish different situation (location of the tumor) and ch			-	
Skills	The student can assess what an inc treatment, sports, social help groups, s				
	Diagnostics				
	The students can suggest solutions analyses.	for repairs of imaging instru	mentation after hav	ing done err	
	The students can classify results of based on their knowledge of anatomy,			ps of diseas	
Personal Competence					
	The students can assess the special professional way.				
Social Competence	The students are aware of the spec	ial, often fear-dominated be	ehavior of sick peo	ple caused	
	Inc				



	diagnostic and therapeutic measures and can meet them appropriately.		
	The students can apply their new knowledge and skills to a concrete therapy case. The students can introduce younger students to the clinical daily routine.		
Autonomy	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves.		
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28		
Credit points	3		
	Written exam		
Examination duration and scale	90 minutes		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory		



Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Ulrich Carl, Prof. Thomas Vestring DE
Workload in Hours Lecturer Language Cycle	Independent Study Time 62, Study Time in Lecture 28 Prof. Ulrich Carl, Prof. Thomas Vestring DE
Lecturer Language Cycle	Prof. Ulrich Carl, Prof. Thomas Vestring DE
Language Cycle	DE
Cycle	
Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units which determine a predefined sequence in their respective departments
	<ul> <li>"Technik der medizinischen Radiologie" von T. + J. Laubenberg – 7. Auflage – Deutscher Ärzteverlag – erschienen 1999</li> <li>"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – 4. Auflage - Verlag Urban &amp; Fischer – erschienen 02.03.2006 ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg – erschiene 08.12.2009</li> </ul>
Literature	ISBN: 978-3-437-47501-6  • "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	<ul> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer –</li> </ul>
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000



Courses				
Title	and Molecular Biology (L0386)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students h	ave reached the following I	earning results	
Professional Competence	The students can			
Knowledge	<ul> <li>describe basic biomolecules;</li> <li>explain how genetic information</li> <li>explain the connection between</li> </ul>			
Skills	<ul> <li>The students can</li> <li>recognize the importance of mole</li> <li>describe selected molecular-diag</li> <li>explain the relevance of these prior</li> </ul>	gnostic procedures;		
Personal Competence				
Social Competence	The students can participate in discussion	ons in research and medici	ne on a technical lev	vel.
Autonomy	The students can develop understand themselves.	ing of topics from the cou	urse, using technica	al literature, b
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Examination				
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Electiv Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Electiv Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

1-



Course L0386: Introduct	ourse L0386: Introduction to Biochemistry and Molecular Biology			
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Hans-Jürgen Kreienkamp			
Language				
Cycle	WiSe			
Content				
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage			
	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008			
Literature				



	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
nequirements	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	The successful completion of the labs will be honored during the evaluation of the module examination according to the following rules:			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory	1
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and	
	Enviromental Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Product Development and Production: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory	
	Computer Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
Assignment for the		
Following Curricula	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental	
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Mechatronics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Aircraft Systems Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Theoretical Mechanical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Energy Systems: Compulsory	
	Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory	
	Computational Ocience and Engineering. Oue qualification. Computisoly	



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	er Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Compute	ourse L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
Workload in Hours	ependent Study Time 46, Study Time in Lecture 14		
Lecturer	Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Courses				
<b>Title</b> Numerical Mathematics I (Li Numerical Mathematics I (Li		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
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-	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Stud II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	ents (german or english) <b>or</b> A	nalysis & Lir	near Algebra
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to</li> <li>name numerical methods for interpolation, integration, least squares problems, eigenvaluproblems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computation and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem ar solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously composed teams (i.e., teams from different study program and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.</li> </ul>			
Autonomy	<ul> <li>Students are capable</li> <li>to assess whether the supporting theoretical and practical excercises are better solver</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in I	_ecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German progr General Engineering Science (German progr Biomechanics: Compulsory General Engineering Science (German progr Materials in Engineering Sciences: Compulso General Engineering Science (German progr General Engineering Science (German progr Compulsory General Engineering Science (German progr Focus Materials in Engineering Sciences: Co	ogram): Specialisation Mech ogram): Specialisation Mech ory ram): Specialisation Biomedica ogram, 7 semester): Specialisation ram, 7 semester): Specialisation	anical Engi anical Engi al Engineeri isation Con	neering, Foc neering, Foc ng:Compulsc nputer Scienc



	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
Assignment for the	Electrical Engineering: Core qualification: Elective Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerica	al Mathematics I		
Тур	Lecture		
Hrs/wk			
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell		
Language	DE/EN		
Cycle	WiSe		
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>		
Literature	<ul> <li>Stoer/Bulirsch: Numerische Mathematik 1, Springer</li> <li>Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer</li> </ul>		



Course L0418: Numerica	Irse L0418: Numerical Mathematics I		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	3		
Workload in Hours	lependent Study Time 62, Study Time in Lecture 28		
Lecturer	f. Sabine Le Borne, Dr. Patricio Farrell		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1333: Bl	O I: Implants and Fracture He	aling		
Courses				
Title Implants and Fracture Heali	ng (L0376)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in Fracture Healing".	"Introduction into Anatomie"	before attending	"Implants and
Educational Objectives	After taking part successfully, students	have reached the following lea	rning results	
Professional Competence				
	The students can describe the difference	rent ways how bones heal,	and the require	ments for their
Knowledge	existence. The students can name different treatments for the spine and hollow bones under given fracture morphologies.			
Skills	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.			
Personal Competence				
Social Competence	The students can, in groups, solve basi	c numerical modeling tasks for	the calculation of	internal forces
Autonomy	The students can, in groups, solve basi	c numerical modeling tasks for	the calculation of	internal forces
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German General Engineering Science (German Focus Biomechanics: Compulsory General Engineering Science (German Compulsory General Engineering Science (English General Engineering Science (English Biomechanics: Compulsory General Engineering Science (English Focus Biomechanics: Compulsory General Engineering Science (English Focus Biomechanics: Compulsory General Engineering Science (English Compulsory Mechanical Engineering: Specialisation Biomedical Engineering: Specialisation	a program): Specialisation Biom a program, 7 semester): Special a program, 7 semester): Special program): Specialisation Biom sh program): Specialisation program, 7 semester): Special program, 7 semester): Special program, 7 semester): Special n Biomechanics: Compulsory ion Artificial Organs and R n Implants and Endoprosthese n Medical Technology and Cor tion Management and Bus	nedical Engineerin lisation Mechanic alisation Biomedic edical Engineerin Mechanical Engin lisation Mechanic lisation Biomedic egenerative Mec s: Elective Compu- torol Theory: Election siness Administr	ng: Compulsor al Engineering g: Compulsory neering, Focus al Engineering al Engineering dicine: Elective lsory ve Compulsory



Тур	Lecture
Hrs/wk	2
СР	3
Vorkload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Michael Morlock
Language	
Cycle	
	<ul><li>Topics to be covered include:</li><li>1. Introduction (history, definitions, background importance)</li></ul>
	<ol> <li>Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)</li> </ol>
	3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine
	3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
Content	
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates
	5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
	Cochran V.B.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
Literature	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible				
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 ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	pintly solve technical problems, a	and experim	entally valida
Autonomy	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				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory			
Process Engineering: Core qualification: Compulsory			

Turn	Lecture
тур Hrs/wk	
CP	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Wise         Signals and systems            Linear systems, differential equations and transfer functions             First and second order systems, poles and zeros, impulse and step response             Stability          Feedback systems             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             Root locus techniques             Root locus design of PID controllers             Frequency response techniques             Bode diagram             Minimum and non-minimum phase systems             Nyquist plot, Nyquist stability criterion, phase and gain margin             Loo shaping, lead lag compensation             Frequency response interpretation of PID control               Time delay systems             Root locus and frequency response of time delay systems             Smith predictor             Digital control             Sampled-data systems, difference equations
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	ecitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1280: ME	D II: Introduction to Physic	ology		
Courses				
Title Introduction to Physiology (L	0385)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
	Dr. Roger Zimmermann			
Admission				
Requirements Recommended	None			
Previous Knowledge	None			
Educational Objectives	After taking part successfully, studen	ts have reached the following lea	arning results	
Professional Competence	The students are			
Knowledge	<ul> <li>The students can</li> <li>describe the basics of the energy metabolism;</li> <li>describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology.</li> </ul>			
Skills	The students can describe the effec of information, development of forces		-	
Personal Competence				
Social Competence	The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrological			
Autonomy	The students can derive answers to questions arising in the course and other physiological areas using technical literature, by themselves.			
Workload in Hours	Independent Study Time 62, Study T	ïme in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering; Compulsor General Engineering Science (English program): Specialisation Mechanical Engineering; Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsor Biomedical Engineering: Specialisation Management and Business Administration: Electiv Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Electiv Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



ourse L0385: Introduction to Physiology			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Roger Zimmermann		
Language	DE		
Cycle	SoSe		
Content			
	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme		
Literature	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier		



Module M0829: Fo	undations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Management	(L0880)	Lecture	3	3
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations unde multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under rise</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	i			
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale					
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory				
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory				
	General Engineering Science (German program): Specialisation Energy and Environmenta				
	Engineering: Compulsory				
	General Engineering Science (German program): Specialisation Civil- and Enviromenta				
	Engeneering: Compulsory				
	General Engineering Science (German program): Specialisation Mechanical Engineering				
	Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory				
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory				
	Computer Science: Core qualification: Compulsory				
	Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory				
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering				
Following Curricula	Compulsory				
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmenta Engineering: Compulsory				
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering				
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering				
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering				
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture				

Compulsor	y
General E	ngineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsor	у
General Er	gineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsor	у
	ngineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsor	
	gineering Science (English program, 7 semester): Specialisation Energy and Enviromental g: Compulsory
•	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	hatronics: Compulsory
	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	nechanics: Compulsory
General Er	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	aft Systems Engineering: Compulsory
	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	erials in Engineering Sciences: Compulsory
	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	pretical Mechanical Engineering: Compulsory
	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering, luct Development and Production: Compulsory
General Er	gineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Ene	gy Systems: Compulsory
Computatio	onal Science and Engineering: Core qualification: Compulsory
Computatio	onal Science and Engineering: Core qualification: Compulsory
Logistics a	nd Mobility: Core qualification: Compulsory
Mechanica	I Engineering: Core qualification: Compulsory
	cs: Core qualification: Compulsory
Naval Arch	itecture: Core qualification: Compulsory
Technoma	hematics: Core qualification: Compulsory
Process Er	gineering: Core qualification: Compulsory



Tvn	Lecture		
Hrs/wk			
CP			
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateginformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project E	intrepreneurship
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M1332: BIC	DI: Experimental Methods	in Biomechanics		
Courses				
<b>Title</b> Experimental Methods in Bio	mechanics (L0377)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentell Methoden".			
Educational Objectives	After taking part successfully, studen	ts have reached the following lear	ming results	
Professional Competence				
Knowledge	The students can describe the different ways how bones heal, and the requirements for the existence. The students can name different treatments for the spine and hollow bones under given fractur morphologies. The students can describe different measurement techniques for forces and movements, and choos the adequate technique for a given task.			
	The students can describe the l biomechanics.	basic handling of several exp	erimental techn	iques used i
Personal Competence				
Social Competence	The students can, in groups, solve ba	asic experimental tasks.		
Autonomy	The students can, in groups, solve ba	asic experimental tasks.		
Workload in Hours	Independent Study Time 62, Study T	ime in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (Gen Biomechanics: Compulsory General Engineering Science (Germ General Engineering Science (Germ Focus Biomechanics: Compulsory General Engineering Science (Germ Compulsory General Engineering Science (Englis General Engineering Science (Englis General Engineering Science (Englis Focus Biomechanics: Compulsory General Engineering Science (Englis Focus Biomechanics: Compulsory General Engineering Science (Englis Focus Biomechanics: Compulsory General Engineering: Specialisat Biomedical Engineering: Specialisat	an program): Specialisation Biom ian program, 7 semester): Special sh program, 7 semester): Special sh program): Specialisation Biome glish program): Specialisation M sh program, 7 semester): Special ish program, 7 semester): Special tion Biomechanics: Compulsory sation Artificial Organs and Re ion Implants and Endoprostheses ion Medical Technology and Com	edical Engineerin isation Mechanic lisation Biomedic edical Engineerin Aechanical Engin isation Mechanic lisation Biomedic egenerative Mec : Elective Compu- trol Theory: Electi	ng: Compulson al Engineering g: Compulson neering, Focu al Engineering al Engineering licine: Electiv lsory ve Compulsor



Course L0377: Experime	ourse L0377: Experimental Methods in Biomechanics		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Michael Morlock		
Language	DE		
Cycle	SoSe		
Content			
Literature	Wird in der Veranstaltung bekannt gegeben		



## Focus Energy Systems

The aim of the specialization Energy Systems in the field of study Mechanical Engineering of the course of study General Engineering Science is to familiarize students with different technologies for energy conversion, energy distribution and energy application. Graduates are qualified to analyse, abstract and model processes. They are able to evaluate data and results and to develop strategies for finding innovative, energy efficient solutions. They take the connection of different problems into account. Furthermore the graduates are able to document and to communicate scientific results.

The specialization Energy Systems enables a consecutive study of the Master Energy Systems or an economical oriented master study.

Title		Гур	Hrs/wk	СР
Computer Engineering (L032 Computer Engineering (L032	,	ecture Recitation Section (small)	3 1	4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules:</li> <li>1. Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs, such that the examination's marks are lifted by 0,3 or 0,4 respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	<ul> <li>This module deals with the foundations of the funct from the assembly-level programming down to gates</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean alg combinational networks</li> <li>Sequential logic: Flip-flops, automata, system</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtra</li> <li>Basics of computer architecture: Program pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRA</li> </ul>	s. The module includes gebra, Boolean functi natic hardware design action, multiplication and mming models, MIPS M, caches	the following ons, hardw division single-cycl	g topics: are synthesi



	specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors.
Skills	After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence	
-	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Social Competence	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration	90 minutes, contents of course and labs
and scale	· · · · · · · · · · · · · · · · · · ·
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the Following Curricula	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	er Engineering			
Тур	Lecture			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Heiko Falk			
Language	DE			
Cycle	WiSe			
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>			
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>			

Course L0324: Computer Engineering				
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Heiko Falk			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

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Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (large	3 e) 1	4 2
			<i>')</i>	-
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
Recommended	The modul is an introduction to the theory of signals and systems. Good knowledge in math covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation (Fourier series, Fourier transform, Laplace transform) is useful but not required.			
Educational Objectives	After taking part successfully, student	s have reached the following learni	ng results	
Professional				
Competence				
	The students are able to classify an methods of signal and system theo	-		-
Knowledge	continuous-time and discrete-time signal			
Knowledge	signals and systems mathematically			
	effects in time domain and image d signal to a discrete-time signal.	omain which are caused by the t	ansition of a o	continuous-tir
	The students are able to describe an	d analyse deterministic signals and	l linear time-in	variant svster
skills sing methods of signal and system theory. They can analyse and design basic system				stems regardi
OMIS	important properties such as magnitu		-	hey can asse
Personal Competence	the impact of LTI systems on the sign	al properties in time and frequency	uomain.	
-	The students can jointly solve specific problems.			
	The students are able to acquire re		e literature sou	urces. They ca
Autonomy	control their level of knowledge durin			
	clicker system.			
	Independent Study Time 124, Study	lime in Lecture 56		
Credit points Examination				
Examination duration				
and scale	90 min			
	General Engineering Science (Germa	an program): Specialisation Electric	al Engineering	g: Compulsory
	General Engineering Science (Germa			
	General Engineering Science (Germa General Engineering Science (Germa		• •	• •
	General Engineering Science (C			
	Engeneering: Compulsory	Derman program), Cresializatio	Maabaaiaa	
	General Engineering Science (C Compulsory	German program): Specialisatio	n Mechanica	I Engineerin
	General Engineering Science (Germa			
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engine			
	Compulsory General Engineering Science (Ger	man program, 7 semester): Spec	ialisation Con	nputer Scienc
	Compulsory			
	General Engineering Science (Gern	nan program, 7 semester): Specia	lisation Proces	ss Engineerin
	Compulsory General Engineering Science (Germ	an program, 7 semester): Specialis	ation Bioproce	ss Engineerin
	Compulsory		-	-
	General Engineering Science (Germ	an program, 7 semester): Specialis	ation Biomedic	al Engineerin
	Compulsory General Engineering Science (Germa	an program, 7 semester): Specialis:	ation Mechanic	al Engineerin



	Constal Engineering Opinion (Cormon program 7 comparise), Constallingtion Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	
Ū	General Engineering Science (English program). Specialisation Grup and Environmental Engeneering.
	Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science, Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



ırse L0432: Signals a	nd Systems			
Тур	Lecture			
Hrs/wk				
СР				
	Independent Study Time 78, Study Time in Lecture 42			
	Prof. Gerhard Bauch			
Language	SoSe			
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>			
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>			



ourse L0433: Signals and Systems				
Тур	Recitation Section (large)			
Hrs/wk	1			
CP	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Gerhard Bauch			
Language	DE/EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			



Typ     Hrs/wk     Cl       Lecture     3     4       Recitation Section (large)     2     2	P	
Lecture 3 4 Recitation Section (large) 2 2		
Recitation Section (large) 2 2		
s I, II and Fluid Dynamics		
s I, II and Fluid Dynamics		
s I, II and Fluid Dynamics		
y, students have reached the following learning results		
sical mechanism of Heat Transfer,		
5,		
nsfer processes in a critical way.		
Heat Transfer,		
- calculate and evaluate complex Heat Transfer processes,		
istent and in small groups.		
cuss in small groups and develop an approach.		
develop a complex problem self-consistent and analyse the renarge with other students is given.	esults in	
0, Study Time in Lecture 70		
nce (German program): Specialisation Mechanical Engineer	ing Foc	
	g, 100	
nce (German program): Specialisation Mechanical Engineer	ing, Foc	
ny ao (Corman program): Specialisation Biomodical Engineering: C	Compulse	
gineering: Compulsory		
ce (German program, 7 semester): Specialisation Mechanical Er	ngineerir	
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ce (English program): Specialisation Biomedical Engineering: C	-	
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nce (English program): Specialisation Mechanical Engineer gineering: Compulsory	ing, Foc	
s r F m iii so dh () - r r r r c r gi c m c c c c r r r r r	, nsfer processes in a critical way. Heat Transfer, nplex Heat Transfer processes, stent and in small groups. cuss in small groups and develop an approach. levelop a complex problem self-consistent and analyse the r ange with other students is given. D, Study Time in Lecture 70 nce (German program): Specialisation Mechanical Engineer ry te (German program): Specialisation Mechanical Engineer ry te (German program): Specialisation Mechanical Engineer ry te (German program): Specialisation Mechanical Engineer ineering: Compulsory te (German program, 7 semester): Specialisation Mechanical Engineer pulsory te (German program, 7 semester): Specialisation Mechanical En- pulsory te (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory te (German program): Specialisation Biomedical Engineering: Compulsory te (German program): Specialisation Biomedical Engineering: Compulsory te (English program): Specialisation Mechanical Engineering: Compulsory te (English program): Specialisation Me	



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Course L0458: Heat Tra	nsfer				
Тур	Lecture				
Hrs/wk	3				
СР	4				
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42				
Lecturer	Dr. Andreas Moschallski				
Language	DE				
Cycle	WiSe				
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods				
Literature	<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996</li> </ul>				

Course L0459: Heat Tra	Course L0459: Heat Transfer				
Тур	Recitation Section (large)				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Dr. Andreas Moschallski				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

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Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
-			-	-
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems	s in time and frequency domain, Lap	lace transfor	m
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to	o jointly solve technical problems,	and experim	entally validat
Autonomy	their controller designs 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 Ti	me in Lecture 56		
Credit points				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German General Engineering Science (Germ Compulsory General Engineering Science (Germa	nan program, 7 semester): Specia	lisation Con	

Computery General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Energy and Environment Engineering Science (German program, 7 semester): Specialisation Process Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biochenins: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biochenins: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials Incinicenting Sciences (Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Incinicenting Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Forderial Bengineering Science (German Program, 7 semester): Specialisation Mechanical Engineering, Focus Forderial Mechanical Engineering, Core qualification: Computery General Engineering Science (German Program, 7 semester): Specialisation Mechanical Engineering, Computery General Engineering Science (English program, 7 semester): Specialisation Computery General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Comp		Compulsory
Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatomics: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Hechatomics: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Hechatomics: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Computery General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering Computery General Engineering Science (English program, 7 semester): Specialisation Mechanic		
Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Process Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Computery General Engineering, Core qualification: Computery General Engineering, Science (English program, 7 semester): Specialisation Computery English and Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery Science Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Nech		
General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Computory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Science (German program, 7 semester): Specialisation Process Engineering: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechanolas: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanolas: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanolas: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mathatis in Engineering Sciences: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Product Devolopment and Production: Computory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Product Devolopment and Production: Computory General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Energy Systems: Computory Bioprocess Engineering: Core qualification: Computory General Engineering Science (English program, 7 semester): Specialisation Computory General Engineering Science (English program, 7 semester): Specialisation Computory General Engineering Science (English program, 7 semester): Specialisation Engineering: Computory General Engineering Science (English program, 7 semester): Specialisation Encercial Engineering Computory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compu		
<ul> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Carpulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture</li> <li>Compulsory</li> <li>General Engineering Science (English program,</li></ul>		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micraft Systems Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fnoetical Mechanical Engineering: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval</li></ul>		
Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrat Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micratia in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fincetical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fincetical Mechanical Engineering: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectures Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Mechatonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Aircraf Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Matrials in Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Corpulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering; Science (English program, 7 semester): Specialisation Mechanical Engineering; Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering; Compulsory</li> <li>General Engineering Science (English progr</li></ul>		
General Engineering Science (German program, 7 semester): Specialisation Process Engineering, Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechancis: 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 Aitcraft Systems Engineering; Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Computer Science: Specialisation Compulsory           General Engineering Science (English program, 7 semester): Specialisation Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compul		
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 Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems 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 Sengy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Liciti Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Liciti Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Enctrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Enctrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering Compulsory General Eng		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Tompulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General</li></ul>		
Focus Mechatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering: Core qualification: Compulsory General Engineering Core qualification: Compulsory General Engineering Science (English program), 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English progra		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering, Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Compulsory</li> <li>General Engineering, Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering, Science (English program, 7 semester): Specialisation Computory</li> <li>Electrical Engineering, Science (English program, 7 semester): Specialisation Computer Science: Specialisation Computational Mathematics: Elective Computery</li> <li>General Engineering, Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Icivil Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Spe</li></ul>		
<ul> <li>Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matrials in Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Electrical Engineering: Core qualification: Compulsory</li> <li>Electrical Engineering Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Rover Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English</li></ul>		
Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Compulsory Computer Science: Specialisation Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program). 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Livil Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Livil Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Livil Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechationic		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation		
Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Corre qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Corre qualification: Compulsory General Engineering: Corre qualification: Compulsory Electrical Engineering: Corre qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Lieutrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Materials in Engineering Science (English program, 7 semester)		
<ul> <li>Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computery</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Forcess Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,</li> <li>Focus Mechatronics: Comp</li></ul>		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Matriatis in Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisatio		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering; Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Shortethanics: Compulsory General Enginee		General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
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Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory	

	ion to Control Systems
	Lecture
Hrs/wk	
CP Warkland in Haure	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         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         Root locus techniques         Root locus design of PID controllers         Frequency response techniques
	Time delay systems   Root locus and frequency response of time delay systems  Smith predictor  Digital control  Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers  Software tools  Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	purse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Γ



Module M0597: Ad	Ivanced Mechanical Engineerin	g Design		
Courses				
Title Advanced Mechanical Engir Advanced Mechanical Engir Advanced Mechanical Engir Advanced Mechanical Engir	neering Design II (L0265) neering Design I (L0262)	<b>Typ</b> Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2	<b>CP</b> 2 1 2 1
			_	•
Module Responsible Admission Requirements				
Recommended Previous Knowledge		eering Design		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solving skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss tech methods.</li> </ul>	nnical information in the lectu	re supporte	ed by activating
Autonomy	<ul> <li>Students are able to independently</li> <li>Students are able to acquire add content e.g. by using the video record</li> </ul>	itional knowledge and to reca		
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
	General Engineering Science (German Energy Systems: Compulsory General Engineering Science (German Aircraft Systems Engineering: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Product Development and Production: Com	program): Specialisation Mech program): Specialisation Mech Isory program): Specialisation Mech program): Specialisation Mech	anical Eng anical Eng anical Eng	ineering, Focu ineering, Focu ineering, Focu



I			
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Theoretical Mechanical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Biomechanics: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Energy Systems: Compulsory		
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Energy Systems: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Aircraft Systems Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Materials in Engineering Sciences: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Mechatronics: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Product Development and Production: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		
	Theoretical Mechanical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Aircraft Systems Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory		
	General Engineering Sciences (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Mechatronics: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Product Development and Production: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Theoretical Mechanical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Biomechanics: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Energy Systems: Compulsory		
	Mechanical Engineering: Core qualification: Compulsory		
	Naval Architecture: Core qualification: Compulsory		



ourse L0264: Advanced Mechanical Engineering Design II		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	Advanced Mechanical Engineering Design I & II  Lecture	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>	



Course L0265: Advance	ourse L0265: Advanced Mechanical Engineering Design II		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



<ul> <li>Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., SpringerAuflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> </ul>	ourse L0262: Advanced Mechanical Engineering Design I		
CP       2         Workload in Hours       Independent Study Time 32, Study Time in Lecture 28         Lecturer       Prof. Dieter Krause, Prof. Otto von Estorff         Language       DE         Cycle       WiSe         Advanced Mechanical Engineering Design I & II         Lecture <ul> <li>Fundamentals of the following machine elements:</li> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Ejcyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> <li>Elements of fluidics</li> <li>Exercise</li> <li>Calculation methods of the following machine elements:</li> <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Sliding bearings</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Calculation methods of the following machine elements:</li> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Calculation methods of the following machine elements:</li> <li>Linear rolling bearings</li> <li>Calculation methods of the following machine elements:</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul> <ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J. Veriag, aktuelle Auflage.</li> <li>Mas</li></ul></ul>		Тур	
Workload in Hours         Independent Study Time 32, Study Time in Lecture 28           Lecturer         Prof. Dieter Krause, Prof. Otto von Estorff           Language         DE           Cycle         WSe           Advanced Mechanical Engineering Design I & II           Lecture         • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings           Content         • Elements of fluidics           Exercise         • Calculation methods of the following machine elements: • Clutches & brakes • Sliding bearings • Axes & shafts • Clutches & brakes • Sliding bearings • Axes & shafts • Clutches & brakes • Sliding bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Epicyclic gears • Crank gears • Stiling bearings • Calculations of hydrostatic systems (fluidics)           Literature         • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Eintifurung in die DIN-Normen; Klein, M., Teubner-Verlag. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente - Gestatlung, Brechnung, Anwendung; Haberhauer, J.		Hrs/wk	
Lecturer       Prof. Dieter Krause, Prof. Otto von Estorff         Language       DE         Cycle       WiSe         Advanced Mechanical Engineering Design 1 & II         Lecture <ul> <li>Fundamentals of the following machine elements:</li> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Crank drives</li> <li>Sliding bearings</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul> Ubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, , Verlag, aktuelle Auflage. <ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestating, Berchorung, Antuelle Auflage.</li> <li>Maschinenelemente - Cschicht, B</li></ul>		СР	
Language       DE         Cycle       WiSe         Advanced Mechanical Engineering Design I & II         Lecture <ul> <li>Fundamentals of the following machine elements:</li> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seats</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> <li>Content</li> <li>Calculation methods of the following machine elements:         <ul> <li>Linear rolling bearings</li> <li>Elements of fluidics</li> </ul> </li> <li>Exercise</li> <li>Calculation methods of the following machine elements:         <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul> </li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J. Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normer; Klein, M., Teubner-Verlag,</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen</li>	ne 32, Study Time in Lecture 28	Workload in Hours	
Cycle       WiSe         Advanced Mechanical Engineering Design I & II         Lecture         • Fundamentals of the following machine elements:         • Linear rolling bearings         • Axes & shafts         • Seals         • Clutches & brakes         • Belt & chain drives         • Gear drives         • Clutches & brakes         • Belt & chain drives         • Carak drives         • Sliding bearings         • Calculation methods of the following machine elements:         • Clutches & brakes         • Sliding bearings         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Clutches & brakes         • Belt & chain drives         • Gear drives         • Epicyclic gears         • Clutches & brakes         • Belt & chain drives         • Belt & chain drives         • Clutches & brakes         • Belt & chain drives         • Cluctores of hydrostatic systems (fluidics)         • Calculat	of. Otto von Estorff	Lecturer	
Advanced Mechanical Engineering Design I & II         Lecture         • Fundamentals of the following machine elements:         • Linear rolling bearings         • Axes & shafts         • Seals         • Clutches & brakes         • Belt & chain drives         • Cack drives         • Epicyclic gears         • Crank drives         • Siding bearings         Content         Exercise         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Axes & shafts         • Clutches & brakes         • Belt & chain drives         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Calculation drives         • Calculation drives         • Calculation gears         • Crank gears         • Sliding bearings         • Calculations of hydrostatic systems (fluidics)         • Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.         Verlag, aktuelle Auflage.         • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.         • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.         • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag, aktuelle Auflage.<	E		
Lecture         • Fundamentals of the following machine elements:         • Linear rolling bearings         • Axes & shafts         • Seals         • Clutches & brakes         • Belt & chain drives         • Gear drives         • Epicyclic gears         • Crank drives         • Silding bearings         • Clutches & brakes         • Sliding bearings         • Elements of fluidics         Exercise         • Calculation methods of the following machine elements:         • Linear rolling bearings         • Axes & shafts         • Clutches & brakes         • Belt & chain drives         • Gear drives         • Epicyclic gears         • Crank gears         • Sliding bearings         • Calculations of hydrostatic systems (fluidics)         • Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J. Verlag, aktuelle Auflage.         • Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J. Verlag, aktuelle Auflage.         • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.         • Maschinenelemente, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.         • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.         • Maschinenelemente 1-2; Schlecht, B., P		Cycle	
<ul> <li>Linear rolling bearings         <ul> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> </li> <li>Content</li> <li>Calculation methods of the following machine elements:         <ul> <li>Linear rolling bearings</li> <li>Elements of fluidics</li> </ul> </li> <li>Exercise</li> <li>Calculation methods of the following machine elements:         <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Crank gears</li> <li>Sliding bearings</li> </ul> </li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>			
<ul> <li>Calculation methods of the following machine elements:         <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> </ul> </li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>	olling bearings shafts s & brakes nain drives ves c gears rives bearings	Content	
<ul> <li>Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, I</li> </ul>	olling bearings shafts s & brakes nain drives ves c gears ears bearings		
<ul> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Vo Vieweg, aktuelle Auflage.</li> </ul>	<ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer</li> </ul>		



Course L0263: Advance	ourse L0263: Advanced Mechanical Engineering Design I		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0655: Co	mputational Fluid Dynamics I			
Courses				
Title Computational Fluid Dynamic Computational Fluid Dynamic		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>СР</b> 3 3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematical Methods for Engineers</li> <li>Fundamentals of Differential/integral calcu</li> </ul>	lus and series expansions	5	
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	The students are able to list the basic numerics of	partial differential equatio	ins.	
Skills	The students are able develop appropriate nume partial differential equations. They can code comp			
Personal Competence Social Competence	The students can arrive at work results in groups a	and document them.		
Autonomy	The students can independently analyse approac	hes to solving specific pro	blems.	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Examination	Written exam			
Examination duration and scale	2h			
-	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



Course L0235: Computa	tional Fluid Dynamics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	<ul> <li>Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.</li> <li>1. Partial differential equations</li> <li>2. Foundations of finite numerical approximations</li> <li>3. Computation of potential flows</li> <li>4. Introduction of finite-differences</li> <li>5. Approximation of convective, diffusive and transient transport processes</li> <li>6. Formulation of boundary conditions and initial conditions</li> <li>7. Assembly and solution of algebraic equation systems</li> <li>8. Facets of weighted -residual approaches</li> <li>9. Finite volume methods</li> <li>10. Basics of grid generation</li> </ul>
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer

Түр	Recitation Section (large)
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
<b>Title</b> Gas and Steam Power Plan Gas and Steam Power Plan		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 2	<b>CP</b> 4 2
Module Responsible			_	_
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>"Technical Thermodynamics I and II"</li> <li>"Heat Transfer"</li> <li>"Fluid Mechanics"</li> </ul>			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	plants or plants equipped with Carbon Capture and Storage.		ne layout of the solution of the solution of the powner of the powner of the solution of the s	
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels a based on well-founded knowledge on the function and construction of gas and steam power plants identify basic associations in the production of heat and electricity, so as to develop concept solutions. Through analysis of the problem and exposure to the inherent interplay between heat a power generation the students are endowed with the capability and methodology to develop reali optimal concepts for the generation of electricity and the production of heat. From the technical base the students become the ability to follow better the deliberations on the electricity mix composite within the energy-political triangle (economy, secure supply and environmental protection). Within the framework of the exercise the students learn the use of the specialised software states EBSILON Professional <sup>TM</sup> . With this tool small practical tasks are solved with the PC, to highli aspects of the design and development of power plant cycles.		power plants, elop conceptu tween heat ar levelop realis rechnical basi nix compositio on). I software sui PC, to highlig	
Personal Competence	An excursion within the framework of the le students get in this manner direct contact with obtain first-hand experience with a power p between technical and political issues.	n a modern power plant in th	is region. T	he students w
Autonomy	The students assisted by the tutors will be ab with these scenario analyses. In this manner is consolidated and the potential effects from of highlighted. The students are able independ	the theoretical and practical different process combination ently to analyse the operati	knowledge 1s and bour	from the lectu dary condition
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration	Written examination of 120 min			



and scale	General Engineering Science (German program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Elective Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Elective Compulsory
	Mechanical Engineering: Specialisation Energy Systems: Compulsory



ourse L0206: Gas and	Steam Power Plants
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting Thermodynamic fundamentals Energy Conversion in thermal power plants Types of power plant Layout of the power plant block Individual elements of the power plant Cooling systems Flue gas cleaning Operation characteristics of the power plants Location of power plants Location of power plants Location of power plants Location of power plants Energy balance of a turbomachine Theory of turbine and compressor stage Equal and positive pressure blading Flow losses Axial and radial design Design features Hydraulic turbomachines Hydraulic turbomachines Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.
Literature	<ul> <li>Kalide: Kraft- und Arbeitsmaschinen</li> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul>



Course L0210: Gas and	Steam Power Plants
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe         In the 1 <sup>st</sup> part of the lecture a general introduction into fluid-flow machines and steam power plants i offered, including:         • Energy balance of a fluid-flow machine         • Theory of turbine and compressor stage         • Equal and positive pressure blading         • Flow losses         • Characteristic numbers         • Axial and radial design         • Design features         • Hydraulic fluid-flow machines         • Pump and water turbine designs         • Design examples of reciprocating engines and turbomachinery         • Steam power plants         • Gas turbine systems         • Diesel engine systems         • Diesel engine systems         • Diese lengine systems         • Diese lengine systems         • Waste heat utilisation         followed by the more specialised issues:         • Electricity Demand and Forecasting         • Thermodynamic fundamentals         • Energy Conversion in Thermal Power Plants         • Types of Power Plant         • Layout of the power plant block         • Individual elements of the power plant         • Cooling systems         • Flue gas cleaning         • Operation characteristics of the power plant         • Coastruction materials         • Location
Literature	<ul> <li>afterwards ask questions and get feedback. The course work has a positive effect on the students final grade.</li> <li>Skripte <ul> <li>Kalide: Kraft- und Arbeitsmaschinen</li> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul> </li> </ul>



Courses				
Title	ting Engineer and Turk-marking	Тур	Hrs/wk	СР
Engines (L0633)	ting Engines and Turbomachinery - Part Reciproc		1	1
Fundamentals of Reciproca Engines (L0634)	ting Engines and Turbomachinery - Part Reciproc	ating Recitation Section (large)	1	1
Internal Combustion Engines		Lecture	2	2
Internal Combustion Engines	s I (L0639)	Recitation Section (large)	1	2
-	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous Knowledge	Thermodynamics, Mechanics, Machine Eleme	nts		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	As a result of the part module "Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals regarding power and working machinery and describe the qualitative and quantitative correlations of operating methods and efficiencies of multiple types of engine compressors and pumps. They are able to utilize technical terms and parameters as well as aspect regarding the development of power density and efficiency, furthermore to give an overview of charging systems, fuels and emissions. The students are able to select specific types of machinery and assess design related and operational problems. As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design.			
Personal Competence Social Competence	The students are able to communicate and cooperate in a professional environment in the field machinery design and application.		it in the field	
Autonomy	The widespread scope of gained knowledge enables the students to handle situations in their futur profession independently and confidently.			
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focu			



Focus Energy Systems: Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory

Course L0633: Fundame	ntals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines	
Тур	Lecture	
Hrs/wk		
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Christopher Friedrich Wirz	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Verbrennungsmotoren <ul> <li>Historischer Rückblick</li> <li>Einteilung der Verbrennungsmotoren</li> <li>Arbeitsverfahren</li> <li>Vergleichsprozesse</li> <li>Arbeitsprozess des wirklichen Motors</li> <li>Wirkungsgrade</li> <li>Gemischbildung und Verbrennung</li> <li>Motorkennfeld und Betriebskennlinien</li> <li>Abgasentgiftung</li> <li>Gaswechsel</li> <li>Aufladung</li> <li>Kräfte im Triebwerk</li> </ul> </li> <li>Kolbenverdichter</li> <li>Thermodynamik des Kolbenverdichters</li> <li>Einteilung und Verwendung</li> <li>Kolbenpumpen</li> <li>Prinzip der Kolbenpumpen</li> <li>Einteilung und Verwendung</li> </ul>	
Literature	<ul> <li>A. Urlaub: Verbrennungsmotoren</li> <li>W. Kalide: Kraft- und Arbeitsmaschinen</li> </ul>	

Course L0634: Fundame	urse L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Christopher Friedrich Wirz		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Course L0059: Internal Combustion Engines I		
Тур	Lecture	
Hrs/wk		
СР		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Thiemann	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>The beginnings of engine development</li> <li>Design of of motors</li> <li>Real process calculation</li> <li>Charging methods</li> <li>Kinematics of the crank mechanism</li> <li>Forces in the engine</li> </ul>	
Literature	<ul> <li>Vorlesungsskript</li> <li>Übungsaufgaben mit Lösungsweg</li> <li>Literaturliste</li> </ul>	

Course L0639: Internal C	Course L0639: Internal Combustion Engines I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Thiemann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0829: Fo	undations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Management	(L0880)	Lecture	3	3
Project Entrepreneurship (Lo	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most importa aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcir supply chain management, organization and human ressource management, informati management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations und multiple objectives and uncertainty, and explain some basic methods from mathematic Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>		b-disciplines i most important t and sourcing ent, informatio situations unde	
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under rie</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods for marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>		y are able to y and under risk us ems	
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>		write a coherer	
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	1 Lecture 70		
Credit points	i			
-	Subject theoretical and practical work			
Examination duration				



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an <del>u scale</del>	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering, Computing General Engineering Science (German program): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compusory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core gualification: Compulsory
 Process Engineering: Core gualification: Compulsory



Tvn	Lecture		
Hrs/wk			
CP			
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateg information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> <li>Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



tion for various types of er	L L L L F nts have reached the students can ciency. They ca tils of power ger The students ca especially for ren ain the environm dologies for det nergy systems.	provide an overview an explain the issues neration, power distrib an explain these aspe newable energy system ental benefits from the	g results of characteri s occurring i pution and por ects, which ar ms and critica e use of such s	in this contex wer trading wil re applicable t al discuss them systems.
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tion for various types of er	nergy systems.		f energy dem	and or energ
Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design them under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for not standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies orally and to put them them into the right context.				
5 7 1		3		
The students are able to analyze suitable technical alternatives and to assess them with technical economical and ecological criteria under sustainability aspects. This allows them to make an effective contribuition to a more sustainable power supply.				
ts can independently exploit nsform it to new questions.	t sources , acqui	re the particular know	ledge about t	he subject are
ndent Study Time 96, Study 1	Time in Lecture 8	84		
swritten exam				
ering: Compulsory I Engineering Science ( nental Engineering: Compuls I Engineering Science (Gern	(German progra sory man program, 7 s mpulsory	am, 7 semester): Semester): Semester): Specialisat	Specialisation	ı Energy anı al Engineerinç
	ering: Compulsory al Engineering Science ( mental Engineering: Compul al Engineering Science (Gerr Energy Systems: Elective Co	s written exam al Engineering Science (German progra ering: Compulsory al Engineering Science (German progra mental Engineering: Compulsory al Engineering Science (German program, 7 Energy Systems: Elective Compulsory	s written exam al Engineering Science (German program): Specialisation ering: Compulsory al Engineering Science (German program, 7 semester): S mental Engineering: Compulsory al Engineering Science (German program, 7 semester): Specialisat	s written exam al Engineering Science (German program): Specialisation Energy and pering: Compulsory al Engineering Science (German program, 7 semester): Specialisation mental Engineering: Compulsory al Engineering Science (German program, 7 semester): Specialisation Mechanic Energy Systems: Elective Compulsory and Environmental Engineering: Core qualification: Compulsory



Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory

Course L0316: Power Industry			
Тур	Lecture		
Hrs/wk			
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Kaltschmitt, Prof. Andreas Wiese		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Electrical energy in the energy system</li> <li>Demand and use of electrical energy (households, industry, "new" buyers (including e-mobility))</li> <li>Electricity generation <ul> <li>electricity generation technologies using fossil fuels and their characteristics</li> <li>combined heat and power technologies and their production characteristics</li> <li>electricity generation from renewable energy technologies and their characteristics</li> </ul> </li> <li>Power distribution <ul> <li>"classic" distribution of electrical energy</li> <li>challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading)</li> </ul> </li> <li>District heating industry</li> <li>Legal and administrative aspects <ul> <li>Energy Act</li> <li>support instruments for renewable energy</li> <li>CHP Act</li> </ul> </li> <li>Cost and efficiency calculation</li> </ul>		
Literature	Folien der Vorlesung		

Course L0315: Energy Systems and Energy Industry			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Energy: development and significance</li> <li>Fundamentals and basic concepts</li> <li>Energy demand and future trends (heat, electricity, fuels)</li> <li>Energy reserve and sources</li> <li>Cost and efficiency calculation</li> <li>Final and effective energy from petroleum, natural gas, coal, uranium and other</li> <li>Legal, administrative and organizational aspects of energy systems</li> <li>Energy systems as a permanent optimization task</li> </ul>		
Literature	Kopien der Folien		



Course L0313: Renewable Energy			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE/EN		
Cycle	SoSe		
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		

Course L1434: Renewable Energy			
Тур	Recitation Section (small)		
Hrs/wk			
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE/EN		
Cycle	SoSe		
Content	<ul> <li>Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer.</li> <li>Possible tasks in the field of renewable energies are: <ul> <li>Solar thermal heat</li> <li>Concentrating solare power</li> <li>Photovoltaic</li> <li>Windenergie</li> <li>Hydropower</li> <li>Heat pump</li> <li>Deep geothermal energy</li> </ul> </li> </ul>		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		



## Focus Aircraft Systems Engineering

The area of specialization "Aircraft System Engineering" prepares participating students for diverse kind of professions in the field of aviation and related industries. Students learn how to use typical methods of systems engineering as well as the application of modern, computer-based techniques for system design, analysis and evaluation. Furthermore required knowledge from different fields of aviation including aircraft systems and air transportation system is discussed.

Additionally students get insight into current research activities, e.g. in the area of fuel cells and electrical energy supply, actuators, avionics systems and software or hydraulic energy supply.

## Module M0597: Advanced Mechanical Engineering Design

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engin	• • • •	Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large) Lecture	2 2	1 2
Advanced Mechanical Engineering Design I (L0262) Advanced Mechanical Engineering Design I (L0263)		Recitation Section (large)	2	1
Module Responsible				
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanica</li> <li>Mechanics</li> <li>Fundamentals of Materials S</li> <li>Production Engineering</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, studer	nts have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvin skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discumethods.</li> </ul>	uss technical information in the lectu	re supporte	d by activatin
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study	Time in Lecture 112		
Credit points	6			
	Written exam			

Module Manual B. Sc. "General Engineering Science (German program, 7 semester)"



Examination duration	120
and scale	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory



Course L0264: Advance	d Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II Lecture
Content	<ul> <li>Fundamentals of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> </li> <li>Elements of fluidics</li> </ul> Exercise <ul> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> </ul> </li> </ul>
	<ul> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer</li> </ul>
	Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen



Course L0265: Advance	ourse L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



ourse L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
	Advanced Mechanical Engineering Design I & II
Content	Lecture
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



Course L0263: Advanced Mechanical Engineering Design I	
Тур	Recitation Section (large)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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Courses				
Title Signala and Swatama (1.042)	2)	Typ	Hrs/wk	CP 4
Signals and Systems (L043) Signals and Systems (L043)		Lecture Recitation Section (large)	3 1	4 2
Module Responsible		(		
Admission				
Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of s covered by the moduls Mathematik 1-3 is expect (Fourier series, Fourier transform, Laplace transfo	ted. Further experience w	ith spectral i	
Educational Objectives	After taking part successfully, students have reach	hed the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe s methods of signal and system theory. They are continuous-time and discrete-time signals and sy signals and systems mathematically in both time effects in time domain and image domain which signal to a discrete-time signal.	e able to apply the fund ystems. They can describe and image domain. In par	amental trar and analys ticular, they	nsformations se determinist understand th
Skills	The students are able to describe and analyse du using methods of signal and system theory. The important properties such as magnitude and pha the impact of LTI systems on the signal properties	ey can analyse and desig ase response, stability, line	n basic sys earity etc Th	tems regardir
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant inforn control their level of knowledge during the lectur clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): General Engineering Science (German program):	: Specialisation Computer : Specialisation Process E : Specialisation Bioproces ogram): Specialisation ogram): Specialisation : Specialisation Biomedica n, 7 semester): Specialisation	Science: Co ngineering: s Engineerir Civil- and Mechanical Il Engineerir tion Electrica sation Com	ompulsory Compulsory ng: Compulso Enviroment Engineering ng: Compulso al Engineering



	Constal Engineering Opinion (Cormon program 7 comparise), Constallingtion Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	
Ū	General Engineering Science (English program). Specialisation Grup and Environmental Engeneering.
	Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science, Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0432: Signals and Systems		
Typ Lecture		
Hrs/wk		
СР	4	
	Independent Study Time 78, Study Time in Lecture 42	
	Prof. Gerhard Bauch	
Language Cycle		
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>	
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>	



ourse L0433: Signals and Systems	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
<b>Title</b> Advanced Mechanical Desiç	n Project (L0266)	<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Mechanical Engineering: Design</li> <li>Advanced Mechanical Engineering</li> </ul>	) Design		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence		- t		
Knowledge	<ul> <li>After passing the module, students are able</li> <li>express the procedure for systemat</li> <li>complex design tasks ,</li> <li>describe working principles, their us</li> <li>explain guidelines for designing for</li> <li>explain advanced use-oriented known</li> </ul>	tically handling of se and combination possibilities r function and manufacturing,	3	
Skills	<ul> <li>After passing the module, students are able to:</li> <li>analyze complex tasks and develop principle solutions using sketches,</li> <li>convert principle solutions into a detailed design,</li> <li>use methods to design and solve engineering design tasks systematically and solutior oriented,</li> <li>create a technical documentation including all necessary technical drawings to understand th functions of the system,</li> <li>document calculations of selected machine elements clearly and in detail.</li> </ul>			
Personal Competence				
Social Competence	After passing the module, students are able present and discuss solutions and t reflect the own results in the work g	technical drawings within groups	5,	
Autonomy	<ul> <li>After passing the module, students are able</li> <li>independently solve complex de necessary knowledge and selecting</li> <li>to independently solve problems.</li> </ul>	esign projects, while motivat	ing themse	lves, acquirir
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science (German Aircraft Systems Engineering: Compulsory General Engineering Science (German Product Development and Production: Cor General Engineering Science (German Theoretical Mechanical Engineering: Comp General Engineering Science (German pro Focus Aircraft Systems Engineering: Comp General Engineering Science (German pro Focus Product Development and Production	program): Specialisation Mech npulsory program): Specialisation Mech pulsory ogram, 7 semester): Specialisatio pulsory ogram, 7 semester): Specialisatio	anical Eng anical Eng on Mechanie	ineering, Focu ineering, Focu cal Engineerin



Assignment for the<br/>Following CurriculaGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Product Development and Production: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>Mechanical Engineering: Core qualification: Compulsory

Course L0266: Advanced Mechanical Design Project		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen	
Language	DE	
Cycle	WiSe	
	<ul> <li>Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.</li> <li>Getriebekonstruktion in Einzelarbeit         <ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> </ul> </li> </ul>	
Content	<ul> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> <li>Lösungsfindung         <ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul> </li> </ul>	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>	

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Courses				
Title Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory and	electrical engineering		
Educational Objectives	After taking part successfully, students have read	hed the following learning	results	
Professional Competence Knowledge	Students are able to describe methods and optimization of mechatronic systems.	calculations for design,	modeling,	simulation a
Skills	Students are able to apply modern algorithms for modeling of mechatronic systems. They can identia simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small			rget groups.
Autonomy	Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German progra Mechatronics: Compulsory General Engineering Science (German progra Aircraft Systems Engineering: Compulsory General Engineering Science (German progra Theoretical Mechanical Engineering: Compulsor General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Elec General Engineering Science (English progra Aircraft Systems Engineering: Compulsory General Engineering Science (English progra Mechatronics: Compulsory General Engineering Science (English progra Theoretical Mechanical Engineering: Compulsor General Engineering Science (English program, Focus Mechatronics: Compulsory General Engineering Science (English program, Focus Mechatronics: Compulsory General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Elec Mechanical Engineering: Specialisation Aircraft S Mechanical Engineering: Specialisation Aircraft S Mechanical Engineering: Specialisation Mechattr Mechanical Engineering: Specialisation Theoret	am): Specialisation Mechan): Specialisation Mechany, 7 semester): Specialisation 7 semester): Specialisation 7 semester): Specialisation (7 semester): Specialisa	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foo neering, Foo al Engineerin al Engineerin al Engineerin neering, Foo neering, Foo al Engineerin al Engineerin al Engineerin

Mechatronics: Core qualification: Compulsory

course L1822: Simulation and Design of Mechatronic Systems	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab <sup>®</sup> and Simulink <sup>®</sup>
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung

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

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

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Courses					
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2	
-			-	-	
Module Responsible					
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	g results		
Professional Competence			-		
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>				
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>				
Personal Competence					
Social Competence	Students can work in small groups t	o jointly solve technical problems,	and experim	entally valida	
Autonomy	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 T	ime in Lecture 56			
Credit points					
Examination	Written exam				
Examination duration and scale	120 min				
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<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Proces Biomechnics: Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Proces Biomechnics: Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Proces Nationals Inconjuncering: Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Proces National Inconnection; Computery</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Proces National Inconnection; Computery</li> <li>General Engineering Science (German Program, 7 semester): Specialisation Mechanical Engineering, Proces Engineering Science (German Program, 7 semester): Specialisation Mechanical Engineering, Computery</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery</li> <li>General Engineering Science (English program, 7 semester): Specialisation Reverse Science Computery</li> <li>General Engineering Science (English program, 7 semester): Specialisation N</li></ul>		Compulsory
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<ul> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Focus Product Development and Production: Compulsory</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Computery</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architect</li></ul>		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrafi Systems Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program): Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory&lt;</li></ul>		
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<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Concus Aircraft Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering: Conce (Garman program, 7 semester): Specialisation Mechanical Engineering; Concus Product Development and Production: Compulsory</li> <li>General Engineering; Core qualification: Compulsory</li> <li>General Engineering; Science (English program, 7 semester): Specialisation Mechanical Engineering; Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English progr</li></ul>		
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<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Invironmental Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Archite</li></ul>		
Focus Mechatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Core qualification: Compulsory General Engineering Core qualification: Compulsory General Engineering Science (English program), 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English prog		
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<ul> <li>Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Forcess Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mech</li></ul>		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatonics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatonics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatonics: Compulsory General Engineering Science (English program, 7 se		
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Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory		

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	Lecture
Hrs/wk CP	
-	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language Cycle	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         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         Root locus techniques         Root locus design of PID controllers         Frequency response techniques
	Digital control
	<ul> <li>Sampled-data systems, difference equations</li> <li>Tustin approximation, digital implementation of PID controllers</li> </ul>
	<ul> <li>Software tools</li> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Examination	Written exam			
Examination duration	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	r Engineering		
Тур	Lecture		
Hrs/wk			
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Compute	Course L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
<b>Title</b> CAE-Team Project (L0271)		<b>Typ</b> Project-/problem-based Learning	<b>Hrs/wk</b> 2	<b>CP</b> 2
Development of Lightweight Integrated Product Develop		Lecture Lecture	2 2	2 2
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
	Advanced Knowledge about engine	ering design:		
Decemented	Fundamentals of Mechanical Engine	eering Design		
Recommended Previous Knowledge	Mechanical Engineering: Design			
	Advanced Mechanical Engineering	Design		
Educational Objectives	After taking part successfully, studer	ts have reached the following learning	results	
Professional Competence				
	After completing the module, studen	ts are capable of:		
Knowledge	<ul> <li>explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems</li> <li>describing the interaction of the different CAE-Systems in the product development process</li> </ul>			
Skills	<ul> <li>After completing the module, students are able to:</li> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such a classification schemes and product structuring</li> <li>design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload</li> </ul>			
Personal Competence	After completing the module, studen	ts are able to:		
Social Competence	<ul> <li>To develop a project plan and allocate work appropriate work packages in the framework or group discussions</li> <li>Present project results as a team for instance in a presentation</li> </ul>			
	Students are capable of:			
Autonomy	independently adapt to a CA	E-Tool and complete a given practical	task with it	
Workload in Hours	Independent Study Time 96, Study 1	ime in Lecture 84		
Credit points				
	Written exam			
Examination duration and scale	90		· · – ·	
	Aircraft Systems Engineering: Comp General Engineering Science (Ge Product Development and Production	rman program): Specialisation Mech on: Compulsory nan program, 7 semester): Specialisati : Compulsory	nanical Engi on Mechanic	ineering, Foc cal Engineerin



Assignment for the<br/>Following CurriculaGeneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft Systems Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>Mechanical Engineering: Specialisation Product Development and Production: Compulsory<br/>Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory<br/>Product Development, Materials and Production: Technical Complementary Course Core Studies:<br/>Elective Compulsory

Course L0271: CAE-Tea	m Project
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul> <li>Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)</li> <li>Team formation, allocation of tasks and generation of a project plan</li> <li>Collective creation of one product out of CAD models supported by FEM calculations and PDM system</li> <li>Manufacturing of selected parts using 3D printer</li> <li>Presentation of results</li> </ul> Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.
Literature	-



Course L0270: Development of Lightweight Design Products			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Benedikt Kriegesmann		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Lightweight design materials</li> <li>Product development process for lightweight structures</li> <li>Dimensioning of lightweight structures</li> </ul>		
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> </ul>		

urse L0269: Integrate	d Product Development I		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction to Integrated Product Development</li> <li>3D CAD -Systems and CAD interfaces</li> <li>Administration of part lists / PDM systems</li> <li>PDM in different industries</li> <li>Selection of CAD-/PDM Systems</li> <li>Simulation</li> <li>Construction methods</li> <li>Design for X</li> </ul>		
Literature	<ul> <li>Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag</li> <li>Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles</li> <li>Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag</li> <li>Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag</li> <li>Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag</li> </ul>		



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Courses				
Title	Тур	Hrs/wk	СР	
Fundamentals of Aircraft Systems (L0741)	Lecture	2	2	
Fundamentals of Aircraft Systems (L0742)	Recitation Section (small)	1	1	
Air Transportation Systems (L0591)	Lecture	2	2	
Air Transportation Systems (L0816)	Recitation Section (large)	1	1	

Module Responsible	Prof. Frank Thielecke	
Admission Requirements	None	
Recommended Previous Knowledge	Basics of mathematics, mechanics and thermodynamics	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.	
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system.	
Personal Competence		
Social Competence	Students are made aware of interdisciplinary communication in groups.	
Autonomy	Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	
Credit points	6	
	Written exam	
Examination duration and scale	150 min	
General Engineering Science (German program): Specialisation Mechanical Engineering, F         Aircraft Systems Engineering: Compulsory         General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer         Focus Aircraft Systems Engineering: Compulsory         General Engineering Science (English program): Specialisation Mechanical Engineering, F         Following Curricula         Aircraft Systems Engineering: Compulsory         General Engineering Science (English program): Specialisation Mechanical Engineering, F         Following Curricula         Aircraft Systems Engineering: Compulsory         General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering         Focus Aircraft Systems Engineering: Compulsory         General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer         Focus Aircraft Systems Engineering: Compulsory         Logistics and Mobility: Specialisation Logistics and Mobility: Elective Compulsory         Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory		



Course L0741: Fundamentals of Aircraft Systems			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Frank Thielecke		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials</li> <li>Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems</li> </ul>		
Literature	- Shevell, R. S.: Fundamentals of Flight - TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis - Wild: Transport Category Aircraft Systems		

Course L0742: Fundamentals of Aircraft Systems		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0591: Air Transportation Systems				
Тур	Typ Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Volker Gollnick			
Language	DE			
Cycle	SoSe			
Content	<ol> <li>Air transport as part of the global transportation system</li> <li>Legal basis of air transportation</li> <li>Safety and security aspects</li> <li>Aircraft basics</li> <li>The role of the aircraft amnufacturer</li> <li>The role of the aircraft operator</li> <li>Airport operation</li> <li>The principles of air traffic management</li> <li>Environmental aspects of air transportation</li> <li>Future perspectives of air transport</li> </ol>			
Literature	<ol> <li>V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5</li> <li>H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003</li> <li>K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0</li> <li>I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5</li> <li>D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3</li> <li>N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4</li> <li>P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8</li> <li>H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0</li> </ol>			

Course L0816: Air Transportation Systems			
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Volker Gollnick		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Practical exercises to understand</li> <li>aircraft movement in wind conditions</li> <li>aircraft performance analyses</li> <li>radio navigation prinicples</li> <li>Objective: Understanding and application of principle methods to practical aviation problems</li> </ul>		
Literature	Hünnecke: Das moderne Verkehrsflugzeug von heute Flühr: Avionik und Flugsicherungstechnik		



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 3
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations unde multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coherer report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	Students are able to			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
Examination	Subject theoretical and practical work			
Examination duration				



and scale	l
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering, Computing General Engineering Science (German program): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	
Following Curricula	
<b>J</b>	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core gualification: Compulsory
 Process Engineering: Core gualification: Compulsory



Τνρ	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kath Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>



Course L0882: Project Entrepreneurship	
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



## **Focus Materials in Engineering Sciences**

In the specialization "materials in the engineering sciences" the graduates learn how to systematically and methodically analyze and understand fundamental materials-related phenomena. They have broad knowledge of the material science basics of structural and functional materials, including metals, polymers and ceramics. The graduates understand the impact of composition, processing, and service conditions on the material's behavior. Based on this understanding they can assess the suitability of materials for specific technological problems.

## Module M0597: Advanced Mechanical Engineering Design

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering Design II (L0264)		Lecture	2	2
Advanced Mechanical Engineering Design II (L0265)		Recitation Section (large)	2	1
Advanced Mechanical Engin		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanica</li> <li>Mechanics</li> <li>Fundamentals of Materials S</li> <li>Production Engineering</li> </ul>			
Educational Objectives	After taking part successfully, studer	nts have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>transfer knowledge learned skills),</li> </ul>	Iculations of covered machine elemen in the module to new requirements inical drawings and schematic sketche	and tasks (	oroblem solvin
Personal Competence				
Social Competence	<ul> <li>Students are able to discumethods.</li> </ul>	ss technical information in the lectu	ire supporte	d by activating
Autonomy		ndently deepen their acquired knowled re additional knowledge and to reca eo recordings of the lectures.	-	
Workload in Hours	Independent Study Time 68, Study T	Time in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			

	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
• • • • • • • • • • • • • • • • • • •	Focus Energy Systems: Compulsory
Assignment for the Following Curricula	Constal Engineering Science (English program); Specialization Machanical Engineering Engu
Tollowing Curricula	Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Aval Architecture: Core qualification: Compulsory



Course L0264: Advance	d Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II Lecture
Content	<ul> <li>Fundamentals of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> </li> <li>Elements of fluidics</li> </ul>
	<ul> <li>Exercise</li> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> </ul> </li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer-Vieweg, aktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen



Course L0265: Advance	ourse L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II  Lecture
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



Course L0263: Advance	ourse L0263: Advanced Mechanical Engineering Design I	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title Signals and Systems (L0432	2)	<b>Typ</b> Lecture	<b>Hrs∕wk</b> 3	<b>CP</b> 4
Signals and Systems (L0433	3)	Recitation Section (large)	1	2
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theo covered by the moduls Mathematik 1-3 is (Fourier series, Fourier transform, Laplace	expected. Further experience w	vith spectral	
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin 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			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific prob	olems.		
Autonomy	The students are able to acquire relevan control their level of knowledge during the clicker system.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German Engeneering: Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro	ogram): Specialisation Process E ogram): Specialisation Bioproces an program): Specialisation an program): Specialisation ogram): Specialisation Biomedic rogram, 7 semester): Specialisat program, 7 semester): Specialis orogram, 7 semester): Specialisati	ingineering: ss Engineerin Civil- and Mechanical al Engineerin tion Electric isation Com ation Proces on Bioproces	Compulsory ng: Compulso Enviroment I Engineerin ng: Compulso al Engineerin nputer Scienc ss Engineerin ss Engineerin
	Compulsory General Engineering Science (German pro Focus Biomechanics: Compulsory	ogram, 7 semester): Specialisatio	on Mechanic	al Engineerin



	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



urse L0432: Signals a	nd Systems		
Тур	Lecture		
Hrs/wk	3		
СР			
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Gerhard Bauch		
Language			
Cycle	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>		
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



ourse L0433: Signals and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0988: Sti	uctural Materials			
Courses				
Title Fundamentals of Mechanical Properties of Materials (L1090) Welding Technology (L1123)		<b>Typ</b> Lecture Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science			
Educational Objectives	After taking part successfully, students have	e reached the following lea	arning results	
Professional Competence				
Knowledge	The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowlegde in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynamic loads. The students get to know the most important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design.			
Skills	The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials. The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory			



Course L1090: Fundamentals of Mechanical Properties of Materials		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Norbert Huber, Dr. Erica Lilleodden	
Language	EN	
Cycle	SoSe	
Content	<ol> <li>Introduction and overview</li> <li>Bonding and crystallography, stress, strain, linear elasticity</li> <li>Plasticity of metallic materials</li> <li>Dislocations: Structure, stress, strain, strain energy</li> <li>Dislocations: Motion and forces</li> <li>Partial dislocations, dislocation interactions, jogs and kinks</li> <li>Strengthening mechanisms</li> <li>Introduction to modelling of materials behaviour, classification of</li> <li>phenomena</li> <li>Linear and nonlinear elasticity</li> <li>Plasticity, tensile loading, cyclic loading</li> <li>Viscoelasticity, effects of loading history, creep, relaxation</li> <li>Viscoplasticity, overstress, rate sensitivity of metallic materials</li> <li>Identification of material parameters</li> </ol>	
Literature	<ul> <li>Hull and Bacon: Introduction to Dislocations (1984)</li> <li>G. Gottstein: Physik. Grundlagen der Materialk. (2001)</li> <li>N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998)</li> <li>P. Haupt: Cont. Mechanics and Theory of Materials (2002)</li> </ul>	



тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	DE
Cycle	WiSe
	<ul> <li>phase transitions, phase diagrams and thermal activated processes</li> <li>fundamentals of steels, heat treatment applications for steels and time temperature transformati diagrams</li> <li>properties of weldable carbon and fine grained steels</li> </ul>
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel
	- structure and properties of non-ferrite metals (aluminum, titanium)
	- NDT/DT Methods for materials and welds
	<ul> <li>gas fusion welding, fundamentals of electric arc welding technologies</li> <li>structure and influence parameters for the welded joint</li> </ul>
Content	<ul> <li>- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas me arc welding (MAG)/Plasma Welding</li> </ul>
	- resistance welding/ polymer welding/ hybrid-welding
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnisc Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit v Schweißkonstruktionen, 2. Aufl., Berlin 2002.



Module M0662: Nu	Imerical Mathematics I			
Courses				
Title Numerical Mathematics I (L0417) Numerical Mathematics I (L0418)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
	Prof. Sabine Le Borne			-
Admission	·			
Requirements	None			
Recommended Previous Knowledge	Il for Technomathematicians	s (german or english) <b>or</b> A	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to</li> <li>name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computationa and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem an solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously composed teams (i.e., teams from different study program and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.</li> </ul>			
Autonomy	<ul> <li>Students are capable</li> <li>to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,</li> <li>to assess their individual progess and, if necessary, to ask questions and seek help.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
	General Engineering Science (German program General Engineering Science (German progr Biomechanics: Compulsory General Engineering Science (German progr Materials in Engineering Sciences: Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Comp	am): Specialisation Mech am): Specialisation Mech ): Specialisation Biomedica am, 7 semester): Specialisatio	anical Engi anical Engi al Engineeri isation Con	neering, Focu neering, Focu ng: Compulson nputer Science



	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:			
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory			
Assignment for the	Electrical Engineering: Core qualification: Elective Compulsory			
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus			
	Biomechanics: Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus			
	Materials in Engineering Sciences: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,			
	Focus Materials in Engineering Sciences: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,			
	Focus Biomechanics: Compulsory			
	Computational Science and Engineering: Core qualification: Compulsory			
	Computational Science and Engineering: Core qualification: Compulsory			
	Process Engineering: Specialisation Process Engineering: Elective Compulsory			

Course L0417: Numerica	al Mathematics I		
Тур	Lecture		
Hrs/wk			
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell		
Language	DE/EN		
Cycle	WiSe		
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>		
Literature	<ul> <li>Stoer/Bulirsch: Numerische Mathematik 1, Springer</li> <li>Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer</li> </ul>		



Course L0418: Numerica	urse L0418: Numerical Mathematics I		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1009: Ma	terial Science Laboratory			
Courses				
•	Title Companion Lecture for Materials Science Laboratory (L1088) Material Science Laboratory (L1235)		<b>Hrs/wk</b> 2 4	<b>CP</b> 2 4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements				
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have	e reached the following lear	ning results	
Professional Competence				
	Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on material sciences to the process of solving practical problems. They identify and overcome typical problems during the realization of experiments in the context of material sciences.			
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are able to effectively present and explain their results alone or in groups in front of a qualified audience.			
Autonomy	Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
	Written exam			
Examination duration and scale	1,5 h written Exam (50%) covering the less	on		
0	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory			



Course L1088: Companion Lecture for Materials Science Laboratory			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Patrick Huber		
Language	DE		
Cycle	WiSe		
Content	Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are indicated in brackets for each experiment: 1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids) 2. notch impact test (elastic properties of solids) 3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions) 4. tensile test (elastic properties of solids) 5. Identificiation of polymers (polymer physics) 6. fiber-reinforced polymers (physical principles of composite materials) 7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics) 8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)		
Literature	<ul> <li>William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&amp;Sons, Asia (2011)</li> <li>William D. Callister, Materials Science and Technology, Wiley&amp; Sons, Inc. (2007)</li> </ul>		

Course L1235: Material	Science Laboratory		
Тур	Practical Course		
Hrs/wk	4		
CP	4		
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56		
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller		
Language	DE		
Cycle	WiSe		
Content			
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II		

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Courses					
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2	
Module Responsible				_	
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 h	nave reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>				
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>				
Personal Competence					
Social Competence	Students can work in small groups to	jointly solve technical problems, a	and experim	nentally valida	
Autonomy	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 Tin	ne in Lecture 56			
Credit points					
Examination					
Examination duration and scale	120 min				
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	an program, 7 semester): Special	isation Con		

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory			
Process Engineering: Core qualification: Compulsory			

Course L0654: Introduct	ion to Control Systems		
Тур	Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	Ξ		
Cycle	WiSe		
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         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         Root locus techniques         Root locus bolts         Root locus design of PID controllers         Frequency response techniques         Noninum 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         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course		
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



<b>.</b>				
		_		
<b>Title</b> Computer Engineering (L032	91)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Computer Engineering (L032		Recitation Section (small)	3 1	4 2
Module Responsible		· · · · · · · · · · · · · · · · · · ·		
Admission				
Requirements	None			
	Basic knowledge in electrical engineering			
	The successful completion of the labs will be examination according to the following rules:	honored during the e	valuation of	the module
Previous Knowledge	<ol> <li>Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>The improvement of the grade 5,0 up to 4,3</li> </ol>	hat the examination's ma	rks are lifted	
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> </li> <li>The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors.</li> </ul> After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Personal Competence				
-	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly
	Studente ero oble te consiste nom la sub-	o oppositio literature and l		bio knowled
	Students are able to acquire new knowledge from with other classes.	n specific merature and to	o associate i	nis knowledę
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination	Written exam			
Examination duration	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	r Engineering		
Тур	ecture		
Hrs/wk			
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Compute	ourse L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1005: En	hanced Fundamentals of Mate	erials Science			
-					
Courses					
Title		Тур	Hrs/wk	CP	
	eramics and Polymers (L1233) eramics and Polymers (L1234)	Lecture Recitation Section (large)	2 1	2 1	
Enhanced Fundamentals: M	,	Lecture	2	3	
Module Responsible	Prof. Gerold Schneider				
Admission Requirements					
•	Module "Fundamentals of Materials Scien	nce"			
Recommended Previous Knowledge	commended Module "Materials Science Laboratory" s Knowledge				
	Module "Advanced Materials"				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results		
Professional					
Competence					
Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, electrica and mass transport, microstructure and phase diagrams. They are capable to explain the corresponding technical terms.				
Personal Competence Social Competence Autonomy	The students are able to apply the a mentioned subjects. The students are capable to understand and polymers. They should be able to crit	independently the structure and pr tally evaluate the profoundness of	opeties of c	eramics, metal	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
	Written exam				
Examination duration and scale	180 min				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory				

## Course L1233: Enhanced Fundamentals: Ceramics and Polymers



Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverlahren         Der Bayer-Prozess zur SIC-Herstellung         Der Acheson-Prozess zur SIC-Herstellung         Der Acheson-Prozess zur SIC-Herstellung         Chemical Vapour Deposition         Pulveraufbereitung         Mahitechnik         Sprühtrockner         3. Formgebung         Arten der Formgebung         Pressen (0 - 15 % Feuchte)         Gießen (-> 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)         Content         4. Sintern         Triebkraft des Sinterns         Effekt von gekrümmen Deerflächen und Diffusionswegen         Sinterstalien des isothermen Festphasensinterns         Herifig scaling laws         Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Brucz-igenschaften von Keramiken         Feszo, ferroelektische Keramiken         Feizo-, ferroelektische Keramiken         Feizo-, ferroelektische Keramiken         Feizo-, ferroelektische Keramiken         Feizo-, ferroelektische Materialeigenschaften         Anwendungen         Keramische Lonenleiter         Ionisch Leitfähigkeit         Dotiertes Zirkonoxid i	Тур	Lecture
Workload in Hous         Independent Study Time 32, Study Time In Lecture 28           Lacturer         Prof. Garold Schnolder, Prof. Bodo Fiedler           Language         DEEN           Cycle         SoSe           1. Einführung         Natürliche "Keraniker" - Steine "Könstliche" Keranik - vom Porzellan bis zur Hochleistungskeranik         Anwendungen v Hochleistungskeranik           2. Pulverherstellung         Einfallung der Pulversyntheseverfahren Der Bager-Prozess zur AI2O3-Herstellung Der Acheson Prozess zur GIC-Herstellung           Mahtlechnik         Sprührockner           3. Formgebung         Preuersprücess zur GIC-Herstellung           Mahtlechnik         Sprührockner           3. Formgebung         Pressen (0 - 15 % Feuchte)           Centert         1. Sintern           Triebkraft des Sinterns         Effekt von gekrümmen Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns           Herring scaling Jaws         Holßsostatisches Pressen           5. Mechanische Eigenschaften von Keramiken         Erastische Eigenschaften von Keramiken           Erastische Konzulfer         Sieter Festigkeit- Festigkeitstreuung           6. Elektrische Materialeigenschaften         Arwendungen           Krestigkeit - Festigkeitstreuung         Sieterschaften von Keramiken           Festigkeit - Festigkeitsteine und Keramiken         Festigkeitsteine und Keramike	Hrs/wk	2
Lecture         Prof. Gerold Schneider, Prof. Bodo Fiedler           Language         DEFN           Cycle         SoSo           1. Einführung         Natürliche "Keramiken" - Steine "Künsliche" Keramik - vom Porzollan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverherstellung         Einfellung der Pulversyntheseverlahren Der Bayer Prozess zur SIO-Herstellung           Der Bayer Prozess zur SIO-Herstellung         Der Acheson-Prozess zur SIO-Herstellung           Der Acheson-Prozess zur SIO-Herstellung         Der Acheson-Prozess zur SIO-Herstellung           Der Acheson-Prozess zur SIO-Herstellung         Der Acheson-Prozess zur SIO-Herstellung           Der Acheson-Prozess zur SIO-Herstellung         Der Bayer SIO-SIO           Pulveraubereitung         Mahltechnik           Sprührockner         3. Formgebung           Pressen (0. 15 % Feuchte)         Giefen (<25 % Feuchte)           Ocntett         4. Sinter           Triebkraft des Sinterns         Elektische Fressen           S. Mechanische Eigenschaften von Keramiken         Elastisches Jinterstädlichen von Keramiken           Elastisches und plastisches Materialiverhalten         Bruchzähligkeit - Linear-elastische Bruchmechanik           Festigkeit-Siche Keramiken         Piezo-, ferroelektrische Materialeigenschaften           Piezo-, ferroelektrische Materialeigenschaften         Anwendungen	СР	2
Language         DEEN           Cycle         SoSa           1. Einführung           Natürliche, Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v           2. Pulverherstellung           Einteilung der Pulversyntheseverfahren           Der Abeson-Prozes zur AU203-Herstellung           Der Acheson-Prozes zur AU203-Herstellung           Chemical Vapour Deposition           Pulveraubereitung           Mahltechnik           Sprühreckner           3. Formgebung           Arten der Formgebung           Pressen () - 15 % Feuchte)           Die Beitsche Formgebung           Pressen () - 15 % Feuchte)           Prestitte Formgebung ferestrestitte formgebung fere (	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Cycle       SoSe         1. Ent/bituring       Natürliche "Keramiken" - Steine "Künstliche" Keramiken" - Vom Porzellan bis zur Hochleistungskeramik       Anwendungen v Hochleistungskeramik         2. Pulverherstellung       Einteilung der Pulversyntheseverfahren Der Bayer-Prozes zur Al203-Herstellung Der Acheson-Prozess zur Su-G-Herstellung         Chemical Vapour Deposition       Pulveraufbereitung         Mahltechnik Sprühtrockner       3. Formgebung         Arten der Formgebung       Pressen (0 - 15 % Feuchle)         Gleben (> 25 % Feuchle)       Gleben (> 25 % Feuchle)         Bible (> 25 % Feuchle)       Feuchte)         Content       4. Sintern         Trebokraft des Sintems       Effekt von gekrümmten Obertlächten und Diffusionswegen Sinterstadien des isothermen Festphasensintems         Heriffsostlächse Pressen       5. Mechanische Eigenschaften von Keramiken         Etastisches und plastische Materialevichatten       Bruchzähigkeit - Leistgeheisteurung         6. Elektrische Eigenschaften von Keramiken       Festigkeit - Enstigkeitsteurung         6. Elektrische Keramiken       Perzo-, ferroelektrische Materialeigenschaften Anwendungen         Keramische Ionenteiter       Ionische Leitfähigkeit         Dotertes Zirkonoxid in der Brennstolfzelle und Lambdasonde       D R H. Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier         D.W. Richerson, Modd	Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
<ol> <li>I. Eintührung</li> <li>Natürliche "Karamik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik</li> <li>Pulverherstellung</li> <li>Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al203-Herstellung</li> <li>Der Arbeson-Prozess zur Sc.C-Herstellung</li> <li>Chemical Vapour Deposition</li> <li>Pulveraufbereitung</li> <li>Mahltechnik</li> <li>Sprührockner</li> <li>Formgebung</li> <li>Arten der Formgebung</li> <li>Prossen (0 15 % Feuchte)</li> <li>Content 4. Sintern</li> <li>Triebkraft des Sinterns</li> <li>Einsteinen Operfaces zur Sc. Herstellung</li> <li>Arten der Formgebung</li> <li>Prossen (0 15 % Feuchte)</li> <li>Gioßen (- 25 % Feuchte)</li> <li>Pasische Formgebung (15 - 25 % Feuchte)</li> <li>Content 4. Sinterns</li> <li>Einst des Sinterns</li> <li>Heiflösostalisches Pressen</li> <li>Mechanische Eigenschaften von Keramiken</li> <li>Elastische Sinterns einsteinsche Materialverhatten</li> <li>Bruchzeitigkei - Linear elastische Bruchmechanik</li> <li>Festigkeit - Eigenschaften von Keramiken</li> <li>Elastisches und plastisches Materialverhatten</li> <li>Bruchzeitigkei - Linear elastische Bruchmechanik</li> <li>Festigkeit - Eigenschaften von Keramiken</li> <li>Ereorelektische Materialeigenschaften</li> <li>Anwendungen</li> <li>Keramische lonenleiter</li> <li>konscha Lingkeit in der Förenstolfzelle und Lambdasonde</li> <li>D H. Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier</li> <li>D.W. Richerson, Modern Ceramics, John Wiley &amp; Sons, New York, 1992</li> <li>W.D. Kingen, Introduction to Geramics, John Wiley &amp; Sons, New York, 1992</li> <li>W.D. Kingen, Introduction to the mechanical properties of ceramics', Cambridge Univer</li></ol>	Language	DE/EN
Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik         2. Pulverherstellung Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur XI2O3-Herstellung Der Acheson-Prozes zur SIC-Herstellung Ochemical Vapour Deposition         Pulveraufbereitung         Mahltechnik Sprühtrockner         3. Formgebung Pressen (0 - 15 % Feuchte)         Palstische Formgebung Pressen (2 - 5% % Feuchte)         Plastische Formgebung (5 - 25 % Feuchte)         Content         4. Sintern         Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Hering scaling laws Heißeostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten Bruchzählgkeit - Linear-Lealstiche Bruchmechanik Festigkeit - Festigkeitstreuung         6. Elektrische Keramiken         Piezo-, forzolektrische Materialeigenschaften Anwendungen         Keramische lonenleiter         Ionische Leiffahigkeit Dotertes Zirkonoxid in der Brennstoffzelle und Lambdasonde         D R H Jones, Michael F. Asthy, Engineering Materials 1, An Introduction to Properties, Applicatic and Design, Elesevier         D.W. Richerson, Modern Ceramics John Wiley & Sons, New York, 1992         W.D. Kingery, Introduction to the mechanical properties of ceramics", Cambridge University Pre 1998	Cycle	SoSe
Content       4. Sintern         Triebkraft des Sinterns       Effekt von gekrümmten Oberflächen und Diffusionswegen         Sinterstadien des isothermen Festphasensinterns       Herring scaling laws         Herißig scaling laws       Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken       Elastisches und plastisches Materialverhalten         Bruchzähigkeit - Linear-elastische Bruchmechanik       Festigkeit- Festigkeitsstreuung         6. Elektrische Eigenschaften von Keramiken       Ferroelektische Keramiken         Piezo-, ferroelektrische Materialeigenschaften       Anwendungen         Keramische lonenleiter       Ionische Leitfähigkeit         Ionische Leitfähigkeit       Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde         D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Application and Design, Elesevier         D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992         W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre 1998		1. Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vo Hochleistungskeramik 2. Pulverherstellung Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition Pulveraufbereitung Mahltechnik Sprühtrockner 3. Formgebung Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte)
and Design, Elesevier D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre 1998		Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen 5. Mechanische Eigenschaften von Keramiken Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung 6. Elektrische Eigenschaften von Keramiken Ferroelektische Keramiken Piezo-, ferroelektrische Materialeigenschaften Anwendungen Keramische lonenleiter Ionische Leitfähigkeit
		D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres 1998



	Polymerwerkstoffe Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 € Kunststoffphysik W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 € Werkstoffkunde Kunststoffe G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 € Kunststoff-Kompendium A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

Course L1234: Enhanced Fundamentals: Ceramics and Polymers		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1086: Enhance	ourse L1086: Enhanced Fundamentals: Metals		
Тур	Typ Lecture		
Hrs/wk	Hrs/wk 2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Jörg Weißmüller, Prof. Patrick Huber		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Corrosion protection</li> <li>Stainless steel</li> <li>Battery materials</li> <li>Supercapacitors</li> <li>Fuel cells</li> <li>Materials for hydrogen storage</li> <li>Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism</li> <li>Magnetic materials</li> <li>Magnetic materials: applications</li> </ul>		
Literature	Vorlesungsskript		



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (L	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busin	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, object strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>		y are able to and under risk s ems	
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	1 Lecture 70		
Credit points	i			
-	Subject theoretical and practical work			
Examination duration	· · · ·			



and scale	
an <del>u scale</del>	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Diopiccess Engineering: Computering
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	
i olioining ourrioulu	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

Compulsory	
General Engineering Science (English program, 7 semester): Specialisa	tion Computer Science:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Bioprocess Engineering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialise	ation Civil Engineering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation E	Energy and Enviromental
Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Mechatronics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Product Development and Production: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering,
Focus Energy Systems: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	I



Typ			
Hrs/wk	p Lecture		
CP			
	Independent Study Time 48, Study Time in Lecture 42		
WORKIOAU III HOUIS	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr		
Lecturer	Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



## **Focus Mechatronics**

In the focus "Mechatronics" students learn next to the knowledge and skills of mechanical engineering deeper knowledge and skills of electrical and mechatronics engineering and are therefore able to solve interdisciplinary problems in mechatronics, those sub-disciplines and related disciplines.

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Advanced Mechanical Engir Advanced Mechanical Engir		Lecture Recitation Section (large)	2 2	2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
RecommendedFundamentals of Mechanical Engineering DesignRecommendedMechanicsPrevious KnowledgeFundamentals of Materials ScienceProduction Engineering				
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional				
Competence	After passing the module, students are able	a ta:		
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:         <ul> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvi skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul> </li> </ul>		oroblem solvin	
Personal Competence				
Social Competence	Students are able to discuss technical information in the lecture supported by activating		d by activatin	
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points				
Examination	Written exam			
Examination duration and scale	1120			
	General Engineering Science (German			. –

	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the	Focus Energy Systems: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
i oliottilig outrioulu	Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory



Course L0264: Advance	ourse L0264: Advanced Mechanical Engineering Design II		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
	Advanced Mechanical Engineering Design I & II Lecture		
Content	<ul> <li>Fundamentals of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> </li> <li>Elements of fluidics</li> </ul>		
	<ul> <li>Exercise</li> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> </ul> </li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>		
Literature	<ul> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>		
	Sowie weitere Bücher zu speziellen Themen		



Course L0265: Advance	urse L0265: Advanced Mechanical Engineering Design II		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



urse L0262: Advanced Mechanical Engineering Design I			
Тур	Lecture		
Hrs/wk	٢ 2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language			
Cycle			
	Advanced Mechanical Engineering Design I & II		
Content	Lecture		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Sprin Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktu Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodensteir Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Sprin Vieweg, aktuelle Auflage.</li> </ul>		



Course L0263: Advance	urse L0263: Advanced Mechanical Engineering Design I		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (large)	3 1	4 2
Module Responsible	·			_
Admission				
Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theo covered by the moduls Mathematik 1-3 is (Fourier series, Fourier transform, Laplace	expected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand th effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant system			
Personal Competence				
Social Competence	The students can jointly solve specific prob			
Autonomy	The students are able to acquire relevant control their level of knowledge during the clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Examination				
Examination duration and scale	90 min General Engineering Science (German pro			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engeneering: Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory	ogram): Specialisation Process E ogram): Specialisation Bioprocess an program): Specialisation an program): Specialisation ogram): Specialisation Biomedica ogram, 7 semester): Specialisation program, 7 semester): Specialisation ogram, 7 semester): Specialisation ogram, 7 semester): Specialisation	ingineering: s Engineerin Civil- and Mechanical al Engineerin tion Electric isation Corr ation Proces on Bioproces	Compulsory ng: Compulso Enviroment Engineerin ng: Compulso al Engineerin nputer Scienc ss Engineerin ss Engineerin al Engineerin
	General Engineering Science (German pro Focus Biomechanics: Compulsory	ogram, / semester): Specialisatio	on Mechanic	ai Engineerin



	Concercil Engineering Colonge (Correct program 7 competer), Concercilisation Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	recimonationation alloss Specialisation III. Engineering Science: Elective Compulsory



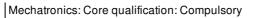
	nd Systems		
Тур	Lecture		
Hrs/wk			
СР			
	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Gerhard Bauch		
Cycle			
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>		
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



Course L0433: Signals and Systems	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
<b>Title</b> Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theor	y and electrical engineering		
Educational Objectives	After taking part successfully, students have	ereached the following learning	results	
Professional Competence	Students are able to describe methods	and calculations for design,	modeling,	simulation a
	optimization of mechatronic systems. Students are able to apply modern algorith	me for modeling of mechatronia	ovetome. Th	
	simulate and design simple systems and in			ley can idem
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.			
Autonomy	Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define further course of study.			
	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Examination	Written exam	_		
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Aircraft Systems Engineering: Compulsory General Engineering Science (German Theoretical Mechanical Engineering: Comp General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Aircraft Systems Engineering: Comp General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (English p Aircraft Systems Engineering: Compulsory General Engineering Science (English p Mechatronics: Compulsory General Engineering Science (English p Theoretical Mechanical Engineering: Comp General Engineering Science (English p Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Aircraft Systems Engineering: Comp General Engineering Science (English pro Focus Theoretical Mechanical Engineering Mechanical Engineering: Specialisation Ai Mechanical Engineering: Specialisation Ai	program): Specialisation Mecha program): Specialisation Mecha pulsory gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation : Elective Compulsory program): Specialisation Mecha program): Specialisation Mecha program, 7 semester): Specialisation gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation : Elective Compulsory roraft Systems Engineering: Com pechatronics: Compulsory	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foo neering, Foo cal Engineeri cal Engineeri cal Engineeri neering, Foo neering, Foo cal Engineeri cal Engineeri cal Engineeri



Course L1822: Simulation and Design of Mechatronic Systems		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab <sup>®</sup> and Simulink <sup>®</sup>	
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung	

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

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



Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible				
Admission Bequirements	None			
Requirements				
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I a			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional				
Competence Knowledge	Students are able to explain the basic methods for calculating electrical circuits. They know the Fourie series analysis of linear networks driven by periodic signals. They know the methods for transien 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.			
Skills	The students are able to calculate currents and voltages in linear networks by means of bas methods, also when driven by periodic signals. They are able to calculate transients in electric circuits in time and frequency domain and are able to explain the respective transient behaviour. The are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.			
Personal Competence				
	Students work on exercise tasks in small guid	ed groups. They are encoura	ged to pres	ent and discus
Social Competence	their results within the group.			
Autonomy	The students are able to find out the required possibilities are given to test their knowledge tests. This allows them to control independent knowledge to other courses like Electrical English	during the lectures continuous their educational objectives	usly by mea s. They can	ins of short-tim
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Examination				
Examination duration and scale	150 min			
Assignment for the Following Curricula	General Engineering Science (German progra General Engineering Science (German progra Mechatronics: Compulsory General Engineering Science (German progra Focus Mechatronics: Compulsory General Engineering Science (German prog Compulsory Electrical Engineering: Core qualification: Con General Engineering Science (English progra General Engineering Science (English progra Focus Mechatronics: Compulsory	gram): Specialisation Mech am, 7 semester): Specialisatio ram, 7 semester): Specialisa npulsory m): Specialisation Electrical E gram): Specialisation Mech	anical Engi on Mechanic tion Electric Engineering anical Engi	neering, Focu cal Engineerin cal Engineerin : Compulsory neering, Focu



General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	WiSe
	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
Content	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
	- 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)
Literature	<ul> <li>- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)</li> <li>- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)</li> </ul>
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newne (2005)

Course L0567: Circuit Theory		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle	WiSe	
Content	see interlocking course	
	siehe korrespondierende Lehrveranstaltung	
Literature	see interlocking course	



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are lifted	examination'
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> </li> <li>The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors.</li> </ul> After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Personal Competence	Students are able to solve similar problems alone	or in a group and to pres	ont the result	s accordingly
Social Competence Autonomy	Students are able to acquire new knowledge from with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Scie	
Contrat Engineering Colonee (Contrat program, 7 Semester). Openation Computer Col	nce:
Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Bioprocess Enginee Compulsory	nng:
General Engineering Science (German program, 7 semester): Specialisation Naval Archited	ture:
Compulsory	ring
General Engineering Science (German program, 7 semester): Specialisation Civil Enginee Compulsory	nng:
General Engineering Science (German program, 7 semester): Specialisation Electrical Engineer	ring:
Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Biomedical Enginee Compulsory	nng:
General Engineering Science (German program, 7 semester): Specialisation Energy	and
Enviromental Engineering: Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Process Enginee Compulsory	nng:
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Mechatronics: Compulsory	ri n n
General Engineering Science (German program, 7 semester): Specialisation Mechanical Enginee Focus Biomechanics: Compulsory	nng,
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer	ring
Focus Materials in Engineering Sciences: Compulsory	nng,
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer	ring
Focus Product Development and Production: Compulsory	mg,
General Engineering Science (German program, 7 semester): Specialisation Mechanical Enginee	ring,
Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory	
Electrical Engineering: Core qualification: Compulsory	
Assignment for the General Engineering Science (English program): Core qualification: Compulsory	
Following Curricula General Engineering Science (English program, 7 semester): Specialisation Computer Science (English program, 7 semester): Specialisation	nce:
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineer	ring:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Naval Archited Compulsory	ture:
General Engineering Science (English program, 7 semester): Specialisation Civil Engineer	ring:
Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Enginee	ring
Compulsory	mg.
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineer	ring:
Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Envirom	ental
Engineering: Compulsory	Sintai
General Engineering Science (English program, 7 semester): Specialisation Process Engineer	ring:
Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee	rina.
Focus Mechatronics: Compulsory	<b>g</b> ,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee	ring,
Focus Aircraft Systems Engineering: Compulsory	_
General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee Focus Materials in Engineering Sciences: Compulsory	ring,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee Focus Product Development and Production: Compulsory	rıng,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer	ring,
Focus Energy Systems: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory	



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	er Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Compute	urse L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible		()		
Admission Requirements				
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	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	intly solve technical problems, a	and experim	entally valida
Autonomy	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				
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	Compulson
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



	Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
-	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
(	Compulsory
F	Process Engineering: Core qualification: Compulsory

ourse 20054. Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         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         Root locus techniques         Root locus bolts         Root locus design of PID controllers         Frequency response techniques         Nyquist plot, Nyquist stability criterion, phase and gain margin         Loop shaping, lead lag compensation         Frequency response interpretation of PID control         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Desig		Lecture	3	4
Semiconductor Circuit Desig		Recitation Section (small)	1	2
Module Responsible				
Admission Requirements	None			
Recommended	Fundamentals of electrical engineering			
Previous Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to explain the functionality of different MOS devices in electronic circuits.</li> <li>Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.</li> <li>Students have solid knowledge about memory circuits and can explain their functionality and specifications.</li> <li>Students are able to explain how analog circuits functions and where they are applied.</li> <li>Students know the appropriate fields for the use of bipolar transistors.</li> </ul>			
Skills	<ul> <li>Students can calculate the specifications of different MOS devices and can define th parameters of electronic circuits.</li> <li>Students are able to develop different logic circuits and can design different types of logic circuits.</li> <li>Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able work efficiently in heterogeneous teams.</li> <li>Students working together in small groups can solve problems and answer professiona questions.</li> </ul>		er professiona	
Autonomy	<ul> <li>Students are able to assess their let</li> </ul>	vel of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German pro General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory	program): Specialisation Mech ogram, 7 semester): Specialisa	anical Engi tion Electric	neering, Focu al Engineering



	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory
	Mechanical Engineering: Specialisation Mechatronics: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Core qualification: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0763: Semicor	nductor Circuit Design
Тур	Lecture
Hrs/wk	3
CF	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecture	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul> From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</li> <li>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</li> <li>URL: http://dx.doi.org/10.1007/978-3-642-20887-4</li> <li>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>URL: http://www.ciando.com/img/bo</li> </ul>



urse L0864: Semicon	ductor Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011 ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867</li> <li>URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499</li> <li>URL: http://dx.doi.org/10.1007/978-3-642-20887-4</li> <li>URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>URL: http://www.ciando.com/img/bo</li> </ul>



Courses					
Title		Тур	Hrs/wk	СР	
Differential Equations 2 (Par	tial Differential Equations) (L1043)	Lecture	2	1	
Differential Equations 2 (Partial Differential Equations) (L1044)		Recitation Section (small)	1	1	
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1	
Complex Functions (L1038)		Lecture	2 1	1	
Complex Functions (L1041)		Recitation Section (small)		1	
Complex Functions (L1042)		Recitation Section (large)	1	1	
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics 1 - III				
Educational Objectives	After taking part successfully, students hav	ve reached the following learning	results		
Professional					
Competence					
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>				
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in th course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concep studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are ab to critically evaluate the results.</li> </ul>				
Personal Competence					
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperating to the needs of their cooperation.</li> </ul>				
Autonomy	<ul><li>can specify open questions precise</li><li>Students have developed sufficien</li></ul>	Students are capable of checking their understanding of complex concepts on their own. The 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 68, Study Time ir	Lecture 112			
Credit points	6				
Examination	Written exam				
Examination duration	60 min (Complex Functions) + 60 min (Difl				



	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	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 Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
_	Mechatronics: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Mechanical Engineering: Specialisation Mechatronics: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory



Course I 1043: Different	ial Equations 2 (Partial Differential Equations)		
	Typ Lecture		
Hrs/wk			
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	<ul> <li>Main features of the theory and numerical treatment of partial differential equations</li> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		

Course L1044: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (small)
Hrs/wk	1
СР	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)	
Тур	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			
Тур	Lecture		
Hrs/wk			
СР			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	ozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		

Тур	Recitation Section (small)
Hrs/wk	
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

ourse L1042: Complex Functions	
Recitation Section (large)	
1	
1	
Independent Study Time 16, Study Time in Lecture 14	
Dozenten des Fachbereiches Mathematik der UHH	
DE	
SoSe	
See interlocking course	
See interlocking course	



Module M0829: Fo	undations of Management			
Courses				
Title	(1.0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (L		Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl	-		
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>and Controlling. In particular they are able to explain the differences between I Management and to name important aspects aspects of entreprneurial projects</li> <li>describe and explain basic busin supply chain management, organ management, innovation management explain the relevance of planning multiple objectives and uncertaint Finance</li> <li>state basics from accounting and compared to the state basics from accounting accoun</li></ul>	Economics and Management t definitions from the field of Ma of and goals in Management a ess functions as production, ization and human ressource ent and marketing and decision making in Busine y, and explain some basic n	nagement nd name the procuremen e manageme ess, esp. in s nethods fror	e most importa t and sourcin ent, informatic situations unde
Skills	Students are able to analyse business uni strategies etc.) and to carry out an Entrepre analyse Management goals and stri analyse organisational and staff stru apply methods for decision making analyse production and procurement analyse and apply basic methods of select and apply basic methods from apply basic methods from accounting	neurship project in a team. In project in a team. In project in a team. In projecture them appropriately inclures of companies under multiple objectives, under the systems and Business inform f marketing in mathematical finance to prede	articular, the r uncertainty ation system	y are able to and under ris sems
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the lareport on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their formation of the statement of</li></ul>	ecture to an entrepreneurship p	project and v	write a cohere
Autonomy	Students are able to <ul> <li>work in a team and to organize the t</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Enviromenta Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	Compulsory
5	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Diomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture
	(200)

	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
<u> </u>	Process Engineering: Core qualification: Compulsory



Τνρ	Lecture		
Hrs/wk			
CP			
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateginformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> <li>Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



## **Focus Product Development and Production**

The specialization Product Development and Production in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Product Development and Production. The specialization maps the product creation process from systematic and methodical development of products, including concept development, design, utilisation of 3D-CAD and Product data management systems, material selection, simulation and test to production, the planning and control and the use of modern manufacturing processes, to high-performance materials.

Courses				
Title		Тур	Hrs/wk	СР
		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large	e) 2 2	1
Advanced Mechanical Engir Advanced Mechanical Engir		Lecture Recitation Section (large		2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge		nical Engineering Design als Science		
Educational Objectives	After taking part successfully, st	udents have reached the following learni	ng results	
Professional				
Competence	After passing the module, stude	nts are able to:		
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elemen of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
	After passing the module, stude	nts are able to:		
Skills	<ul> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvin skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to or methods.</li> </ul>	iscuss technical information in the lea	cture supporte	ed by activatin
Autonomy	<ul> <li>Students are able to a</li> </ul>	ependently deepen their acquired knowle cquire additional knowledge and to re video recordings of the lectures.	-	
Workload in Hours	Independent Study Time 68, St	dy Time in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration	120			



and scale	
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	Energy Systems: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	ravar / nonicolaro. Oolo quanication. Computery



Course L0264: Advance	d Mechanical Engineering Design II	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language		
Cycle	SoSe	
	Advanced Mechanical Engineering Design I & II	
Content	Lecture	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>	



Course L0265: Advance	ourse L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	





Course L0263: Advance	Course L0263: Advanced Mechanical Engineering Design I	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Production Engineering I (LC	0608)	Lecture	2	2
Production Engineering I (LC		Recitation Section (large)	1	1
Production Engineering II (L Production Engineering II (L		Lecture Recitation Section (large)	2 1	2 1
		necitation Section (large)	I	I
Module Responsible Admission	Prof. Wolfgang Hintze			
Requirements	NONE			
	no course assessments required			
Recommended Previous Knowledge	internship recommended			
		and the filler falls of the state of the		
Educational Objectives Professional	After taking part successfully, students have	reached the following learning	results	
Competence				
	Students are able to			
	<ul> <li>name basic criteria for the selection</li> </ul>	of manufacturing processes		
	<ul> <li>name the main groups of Manufactu</li> </ul>			
	<ul> <li>name the application areas of difference</li> </ul>	ent manufacturing processes.		
Knowledge	<ul> <li>name boundaries, advantages and on the series of the series</li></ul>			
	<ul> <li>describe elements, geometric properties workpiece and process.</li> </ul>	erties and kinematic variables	and require	ments for too
	<ul> <li>explain the essential models of man</li> </ul>	ufacturing technology.		
	Students are able to			
	<ul> <li>select manufacturing processes in a</li> </ul>	ccordance with the requirement	S.	
	<ul> <li>design manufacturing processes f</li> </ul>			erances of th
Skills				
	<ul> <li>assess components in terms of their</li> </ul>	production-oriented constructio	n.	
Personal Competence				
	Students are able to			
	<ul> <li>develop solutions in a production e</li> </ul>	nvironment with qualified perso	onnel at tecl	nnical level ar
Social Competence				
	Students are able to			
	<ul> <li>interpret independently the manufacture</li> </ul>			
A .	<ul> <li>assess own strengths and weakness</li> </ul>	ses in general.		
Autonomy	<ul> <li>assess their learning progress and</li> <li>assess possible consequences of th</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration	120 min			
and scale				



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 General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory
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Course L0608: Production	on Engineering I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
Literature	<ul> <li>Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;)</li> <li>Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007</li> <li>Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004</li> <li>Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008</li> <li>Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008</li> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)</li> <li>Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006</li> <li>Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996</li> <li>Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)</li> </ul>

Course L0612: Production	ourse L0612: Production Engineering I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0610: Production	on Engineering II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Geometrically undefined machining (grinding, lapping, honing)</li> <li>Introduction into erosion technology</li> <li>Introduction into blastig processes</li> <li>Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites)</li> <li>Fundamentals of Laser Technology</li> <li>Process versions and Fundamentals of Laser Joining Technology</li> </ul>
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.] : Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007

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



Courses				
Title Advanced Mechanical Design Project (L0266)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Mechanical Engineering: Design</li> <li>Advanced Mechanical Engineering</li> </ul>	Design		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence	After passing the module, students are able	to:		
Knowledge	<ul> <li>express the procedure for systematic</li> <li>complex design tasks ,</li> <li>describe working principles, their us</li> <li>explain guidelines for designing for</li> <li>explain advanced use-oriented know</li> </ul>	cally handling of e and combination possibilities function and manufacturing,	,	
Skills	<ul> <li>After passing the module, students are able to:</li> <li>analyze complex tasks and develop principle solutions using sketches,</li> <li>convert principle solutions into a detailed design,</li> <li>use methods to design and solve engineering design tasks systematically and solution oriented,</li> <li>create a technical documentation including all necessary technical drawings to understand the functions of the system,</li> <li>document calculations of selected machine elements clearly and in detail.</li> </ul>			
Personal Competence				
Social Competence	After passing the module, students are able • present and discuss solutions and te • reflect the own results in the work groups of the state of th	echnical drawings within groups	5,	
Autonomy	<ul> <li>After passing the module, students are able</li> <li>independently solve complex de necessary knowledge and selecting</li> <li>to independently solve problems.</li> </ul>	sign projects, while motivati	ing themse	lves, acquirir
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Com General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prop Focus Aircraft Systems Engineering: Comp General Engineering Science (German prop Focus Product Development and Production	program): Specialisation Mech pulsory program): Specialisation Mech ulsory gram, 7 semester): Specialisatio ulsory gram, 7 semester): Specialisatio	anical Eng anical Eng on Mechanic	ineering, Focu ineering, Focu cal Engineerin



Assignment for the<br/>Following CurriculaGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Product Development and Production: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>Mechanical Engineering: Compulsory<br/>Mechanical Engineering: Compulsory

Course L0266: Advanced Mechanical Design Project			
Typ Project-/problem-based Learning			
Hrs/wk	4		
СР	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.</li> <li>Getriebekonstruktion in Einzelarbeit <ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> </ul> </li> <li>Lösungsfindung <ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springe Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktue Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Courses				
<b>Fitle</b> Fundamentals of Machine To Fundamentals of Machine To Forming and Cutting Techno Forming and Cutting Techno	ools (L1992) blogy (L0613)	<b>Typ</b> Lecture Recitation Section (large) Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 1 2 1	<b>CP</b> 2 1 2 1
	Prof. Wolfgang Hintze	(digo)		
Admission Requirements				
Recommended Previous Knowledge	without major course assessment internship recommended Previous knowledge in mathematic	cs, mechanics and electrical engineering	9	
Educational Objectives	After taking part successfully, stude	ents have reached the following learning	results	
Professional				
Competence				
Knowledge	<ul> <li>machine tool industry.</li> <li>explain types, constructions and functions of CNC-machines and give an overview on m machine systems.</li> <li>explain equipment components.</li> </ul>		ning, machining	
Skills	<ul> <li>Students are able to</li> <li>select tool geometry, cutting materials, process parameters and appropriate measuri technique in accordance with the requirements.</li> <li>estimate occurring forces and temperatures during chip formation.</li> <li>select appropriate machine tools for machining and create NC programs for turning a milling.</li> <li>assess the quality of a machine tools and to detect weak points.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>develop solutions in a proc represent decisions.</li> </ul>	duction environment with qualified pers	onnel at tec	hnical level and
Autonomy	<ul> <li>assess own strengths and v</li> </ul>	rograms. ine tools by reference to appropriate rec weaknesses in general. ess and define gaps to be improved.	uirements.	
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points				
-	Written exam			
Examination duration and scale	180 min			



Assignment for the Following Curricula	I Product Development and Production' Compulsory
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Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Thorsten Schüppstuhl
Language	
Cycle	
	Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
Content	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
Literature	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
	ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006



Course L1992: Fundame	Course L1992: Fundamentals of Machine Tools	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0613: Forming	and Cutting Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Thermomechanical Principles and Models of Machining</li> <li>Chip Formation, Forces, Temperature and Tribology process</li> <li>Wear mechanisms and wear patterns</li> <li>Machinability by Cutting and Forming, Specific Problems of Light Weight Structures</li> <li>Cutting Material and Coatings</li> <li>Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools</li> </ul>
Literature	Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002) Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004) König, W., Klocke, F.; Fertigungsverfahren Bd. 4 <i>Massivumformung</i> , 4. Auflage, VDI-Verlag (1996) König, W., Klocke, F.; Fertigungsverfahren Bd. 5 <i>Blechbearbeitung</i> , 3. Auflage, VDI-Verlag (1995) Klocke, F., König, W.; Fertigungsverfahren <i>Schleifen, Honen, Läppen</i> , 4. Auflage, Springer Verlag (2005) König, W., Klocke, F.: Fertigungsverfahren <i>Drehen, Fräsen, Bohren</i> , 7. Auflage, Springer Verlag (2002)

Course L0614: Forming	Course L0614: Forming and Cutting Technology	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible		· · · · · ·		
A dunia a ia n	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the arks are lifted	examination
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence	This module deals with the foundations of the fur	otionality of computing a	watoma lt ca	vore the love
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses</li> </ul>			
Skills	The students perceive computer systems from the structure and the physical composition of compu- specific and individual computers can be built ba They are able to distinguish between and to computing systems - from gates and circuits up to After successful completion of the module, the between a physical computer system and the understand the consequences that the execution layers from the assembly language down to gat impact that these low abstraction levels have o feasible options.	ter systems. The studen used on a collection of ferent at complete processors. students are able to jur software executed on of software has on the h tes. This way, they will b	ts can analy wand simplostraction lay dge the inte it. In particu ardware-cer be enabled	ze, how high e component vers of today rdependencie ilar, they sha tric abstraction to evaluate th
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly
Autonomy	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate	this knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory
Assignment for the Following Curricula	
i olioning ourrould	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory
	computational objence and Engineering. Oure qualification. Computitory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	r Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Compute	urse L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-			_	_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic particular explain properties of firs</li> <li>They can explain the dynamics of terms of frequency response and of They can explain the Nyquist stab</li> <li>They can explain the role of the plot of the plot of the can explain the way a PIE response</li> <li>They can explain issues arising implemented digitally</li> </ul>	t and second order systems of simple control loops and inte- root locus ility criterion and the stability marg nase margin in analysis and synth Controller affects a control loo	rpret dynam gins derived esis of contr p in terms o	ic properties from it. rol loops of its frequenc
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain a vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus a frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tir and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	pintly solve technical problems, a	and experim	entally valida
Autonomy	Students can obtain information from provided sources (lecture notes, software documentati 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				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

Computer Computery C		Compulsory
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<ul> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering;</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Carpulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture</li> <li>Compulsory</li> <li>General Engineering Science (English program,</li></ul>		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micraft Systems Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering. Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fnoetical Mechanical Engineering: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval</li></ul>		
Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Michatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrat Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micratia in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fincetical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Fincetical Mechanical Engineering: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectures Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Mechatonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Aircraf Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Cous Matrials in Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Corpulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering; Science (English program, 7 semester): Specialisation Mechanical Engineering; Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering; Compulsory</li> <li>General Engineering Science (English progr</li></ul>		
General Engineering Science (German program, 7 semester): Specialisation Process Engineering, Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechancis: 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 Aitcraft Systems Engineering; Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory           General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Computer Science: Specialisation Compulsory           General Engineering Science (English program, 7 semester): Specialisation Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compul		
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 Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrath Systems 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 Sengy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Liciti Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Liciti Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Enctrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Enctrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering Compulsory General Eng		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Tompulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General</li></ul>		
Focus Mechatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producton: Compulsory General Engineering: Core qualification: Compulsory General Engineering Core qualification: Compulsory General Engineering Science (English program), 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English progra		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering, Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Compulsory</li> <li>General Engineering, Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering, Science (English program, 7 semester): Specialisation Computory</li> <li>Electrical Engineering, Science (English program, 7 semester): Specialisation Computer Science: Specialisation Computational Mathematics: Elective Computery</li> <li>General Engineering, Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Icivil Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Spe</li></ul>		
<ul> <li>Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matrials in Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Electrical Engineering: Core qualification: Compulsory</li> <li>Electrical Engineering Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Rover Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English</li></ul>		
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<ul> <li>Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computery</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Forcess Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,</li> <li>Focus Mechatronics: Comp</li></ul>		
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Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory

ourse L0654: Introduction to Control Systems		
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         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         Root locus techniques         Root locus design of PID controllers         Frequency response techniques         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         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course	
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>	



Course L0655: Introduct	ourse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses					
Title CAE-Team Project (L0271)		<b>Typ</b> Project-/problem-based	<b>Hrs/wk</b> 2	<b>CP</b> 2	
Development of Lightweight Integrated Product Develop	,	Learning Lecture Lecture	2 2	2 2	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
	Advanced Knowledge about enginee	ring design:			
Pasammandad	Fundamentals of Mechanical Engineering Design				
Recommended Previous Knowledge	Mechanical Engineering: Design				
	Advanced Mechanical Engineering D	Design			
Educational Objectives	After taking part successfully, student	s have reached the following learning	results		
Professional Competence					
	After completing the module, students	s are capable of:			
Knowledge		ciple of 3D-CAD-Systems, PDM- and I ne different CAE-Systems in the produ			
Skills	<ul> <li>After completing the module, students are able to:</li> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such a classification schemes and product structuring</li> <li>design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload</li> </ul>				
Personal Competence	After completing the module, students	s are able to:			
Social Competence	group discussions	d allocate work appropriate work par am for instance in a presentation	ckages in th	ne framework	
Autonomy	<ul> <li>Students are capable of:</li> <li>independently adapt to a CAE-Tool and complete a given practical task with it</li> </ul>				
	Independent Study Time 96, Study Time in Lecture 84				
Credit points Examination	Written exam				
Examination duration and scale					
	Aircraft Systems Engineering: Compu General Engineering Science (Ger Product Development and Production	man program): Specialisation Mech n: Compulsory an program, 7 semester): Specialisati Compulsory	anical Engi on Mechanic	neering, Focu cal Engineerin	



Assignment for the<br/>Following CurriculaGeneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft Systems Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>Mechanical Engineering: Specialisation Product Development and Production: Compulsory<br/>Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory<br/>Product Development, Materials and Production: Technical Complementary Course Core Studies:<br/>Elective Compulsory

Course L0271: CAE-Tea	m Project
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul> <li>Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)</li> <li>Team formation, allocation of tasks and generation of a project plan</li> <li>Collective creation of one product out of CAD models supported by FEM calculations and PDM system</li> <li>Manufacturing of selected parts using 3D printer</li> <li>Presentation of results</li> </ul> <b>Description</b> Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.
Literature	-



Course L0270: Development of Lightweight Design Products			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Benedikt Kriegesmann		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Lightweight design materials</li> <li>Product development process for lightweight structures</li> <li>Dimensioning of lightweight structures</li> </ul>		
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> </ul>		

Course L0269: Integrated Product Development I			
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction to Integrated Product Development</li> <li>3D CAD -Systems and CAD interfaces</li> <li>Administration of part lists / PDM systems</li> <li>PDM in different industries</li> <li>Selection of CAD-/PDM Systems</li> <li>Simulation</li> <li>Construction methods</li> <li>Design for X</li> </ul>		
Literature	<ul> <li>Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag</li> <li>Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles</li> <li>Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag</li> <li>Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag</li> <li>Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag</li> </ul>		



Module M1005: En	hanced Fundamentals of Mate	erials Science		
Co				
Courses		<b>T</b>	l luc hada	0.0
Title Enhanced Fundamentals: C	eramics and Polymers (L1233)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
	eramics and Polymers (L1234)	Recitation Section (large)	1	1
Enhanced Fundamentals: M	letals (L1086)	Lecture	2	3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
	Module "Fundamentals of Materials Scier	nce"		
Recommended Previous Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional				
Competence	The students are able to give an enhance	ad avanuing over the following teni	00	
Knowledge	in metals, polymers and ceramics: Atomic and mass transport, microstructure a	bonds, crystal and amorphous st	ructures, de	
Skills Personal Competence Social Competence Autonomy	The students are able to apply the appendix mentioned subjects. The students are capable to understand i and polymers. They should be able to crit	ndependently the structure and pr	opeties of c	eramics, metal
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German Materials in Engineering Sciences: Comp General Engineering Science (German p Focus Materials in Engineering Sciences General Engineering Science (German p Focus Product Development and Product General Engineering Science (English Materials in Engineering Sciences: Comp General Engineering Science (English p Focus Materials in Engineering Sciences General Engineering Science (English p Focus Materials in Engineering Sciences General Engineering Science (English p Focus Product Development and Product Mechanical Engineering: Specialisation M Technomathematics: Specialisation III. Er Technomathematics: Core qualification: E	oulsory rogram, 7 semester): Specialisation : Compulsory rogram, 7 semester): Specialisation ion: Compulsory program): Specialisation Mecha oulsory rogram, 7 semester): Specialisation : Compulsory rogram, 7 semester): Specialisation ion: Compulsory Materials in Engineering Sciences ingineering Science: Elective Comp	on Mechanic on Mechanic anical Engi on Mechanic on Mechanic : Compulso	cal Engineering cal Engineering neering, Focus cal Engineering cal Engineering

Course L1233: Enhanced Fundamentals: Ceramics and Polymers



Hrswk 2         CP       2         Workload In Meyendemt Study Time 32, Study Time in Lecture 28         Lecturer       Prof. Gerold Schneider, Prof. Bodo Fiedler         Language       DE/EN         SoSe       SoSe         1. Einführung       Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochteistungskeramik Anwendungen vo Hochteistungskeramik         2. Pulverherstellung       Einteilung der Pulversyntheseverfahren Der Absen-Prozes zur XI2O3-Herstellung         Der Acheson-Prozes zur SIC-Herstellung       Mahltechnik         Sprühtrockner       3. Formgebung         Arten der Formgebung       Pulveraufbereitung         Mahltechnik       Sprühtrockner         3. Formgebung       Pressen (0 - 15 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)       Plastische Formgebung (15 - 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)       Plastische Formgebung (15 - 25 % Feuchte)         Hering scaling laws       Herifig scaling laws         Herifig scaling laws       Herifigscalisches Pressen         S. Mechanische Eigenschaften von Keramiken       Eiskinsche Eigenschaften von Keramiken </th <th>CP         2           Worklead In Hours         Independent Study Time 32, Study Time in Lecture 28           Lecturer         Prot. Gerold Schneider, Prot. Bodo Fiedler           Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Könstliche", Keramiken" - Steine "Könstliche", Keramiken" - vom Porzellan bis zur Hochleistungskeramik         Anwendungen v Hochleistungskeramik           2. Pulveriorstellung         Einteilung der Pulvorsyntheseverfahren Der Bayer-Prozess zur AU203 Herstellung           Der Acheson-Prozess zur 30: CH-Herstellung         Formgebung           Arten der Formgebung         Pulveraufbereilung           Mahltechnik         Sprührtockner           3. Formgebung         Arten der Formgebung (15 - 25 % Feuchte)           Plasische Formgebung (15 - 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)           Reflex von gekümmen Oberflächen und Diflusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws         Heißisselatische Sundermiken           Elastisches und plastische Studerheiten         Elastisches Eigenschaften von Keramiken           Elastisches und plastisches Materialverhalten Elastisches und plastisches Materialverhalten Elastisches und plastisches Materialverhalten Elastisches Leifschijkört           Broch-Ereicelktrische Materialeigenschaften Anwendungen         Keramische lonenteiter Lonische Leifschijkört</th> <th>Тур</th> <th>Lecture</th>	CP         2           Worklead In Hours         Independent Study Time 32, Study Time in Lecture 28           Lecturer         Prot. Gerold Schneider, Prot. Bodo Fiedler           Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Könstliche", Keramiken" - Steine "Könstliche", Keramiken" - vom Porzellan bis zur Hochleistungskeramik         Anwendungen v Hochleistungskeramik           2. Pulveriorstellung         Einteilung der Pulvorsyntheseverfahren Der Bayer-Prozess zur AU203 Herstellung           Der Acheson-Prozess zur 30: CH-Herstellung         Formgebung           Arten der Formgebung         Pulveraufbereilung           Mahltechnik         Sprührtockner           3. Formgebung         Arten der Formgebung (15 - 25 % Feuchte)           Plasische Formgebung (15 - 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)           Reflex von gekümmen Oberflächen und Diflusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws         Heißisselatische Sundermiken           Elastisches und plastische Studerheiten         Elastisches Eigenschaften von Keramiken           Elastisches und plastisches Materialverhalten Elastisches und plastisches Materialverhalten Elastisches und plastisches Materialverhalten Elastisches Leifschijkört           Broch-Ereicelktrische Materialeigenschaften Anwendungen         Keramische lonenteiter Lonische Leifschijkört	Тур	Lecture
Workload in Hours         Independent Study Time 32, Study Time in Lecture 28           Lecturer         Prof. Cerold Schneider, Prof. Bodo Fiedler           Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vor Hochleistungskeramik           2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur AI2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Der Acheson-Prozess zur SiC-Herstellung Persenen vom Sich Freistellung           Mahltechnik Sprühtrockner         3. Formgebung Prossen (0 - 15 % Feuchte) Gießen (2 5 % Feuchte) Gießen (2 5 % Feuchte)           Vontent         4. Sintern           Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstalien des isothermen Festphasensinterns Herring scaling Jaws Heißisostatisches Pressen           5. Mechanische Eigenschaften von Keramiken         Elsetlisches und plastisches Materialverhalten Bruchzähigkeit - Linea-elastische Bruchmechanik Festigkeit - Festigkeitstreuung           6. Elektrische Keramiken         Fercoelektrische Materialserhalten Fercoelektrische Keramiken           Fercoelektrische Keramiken         Fercoelektrische Materialserhalten Arten der Sinderställen des isothersen Effekt von gekrümmten Oberflächen und Keramiken           Fercoelektrische Keramiken         Fercoelektrische Keramiken           Fercoelektrische Keramiken         Fercoelektrische Materialserialser	Workload in Hours         Independent Study Time 32, Study Time in Lecture 28           Lecture         Proi. Geroid Schneider, Prof. Bodo Fiedler           Language         DE/EN           Orget         SoSo           1. Einführung         Natürliche, Keramiken* - Steine , Künstliche Keramik           2. Pulverherstellung         Einfallung der Pulversynhaseverfahren Der Bayer-Prozess zur AI2O3-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung           Wahltechnik         Sprührtockner           3. Formgebung         Arten der Formgebung Pressen (0. 15 % Feuchte)           Die Bayer 12 % Feuchte)         Plastische Formgebung Pressen (0. 15 % Feuchte)           Biltek von gekümmten Oberllächen und Diffusionswegen Sinterstaden des tohermen Festphasensinterns Herring scaling isothermen Pestphasensinterns Herring scaling laws Herißizestatisches Eigenschaften von Keramiken           Eistektore Eigenschaften von Keramiken         Eistektore Eigenschaften von Keramiken           Eistektore Eigenschaften von Keramiken         Feroelektische Keramiken           Piezo-, feroelektische Materialeigenschaften Arwendungen         Dr. H. Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properlies, Applicatio and Design, Elsevier           D. R. H. Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properlies, Applicatio and Design, Elsevier         D.W. Rinderson, Modem Ceramic, John Wiley & Sons, New York, 1992	Hrs/wk	2
Lecturer       Prof. Gerold Schneider, Prof. Bodo Fiedler         Language       DE/EN         Cycle       SoSe         1. Einführung       Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vor Hochleistungskeramik         2. Pulverherstellung       Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur ACO3-Herstellung Der Acheson-Prozess zur SIC-Herstellung         Mahltechnik       Sprührockner         3. Formgebung       Arten der Formgebung Pressen (0 - 15 % Feuchte)         Gleßen (- 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)         Content         4. Sintern         Triebkraft des Sinterns         Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns         Herifig scaling laws         Heißisochse Liegenschaften von Keramiken         Elsektrische Eigenschaften von Keramiken         Elektrische Eigenschaften von Keramiken	Lecturer         Prof. Gerold Schneider, Prof. Bado Fiedler           Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Konsitche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverherstellung         Einteilung der Pulversyntheseverlahren Der Bayer Porzess zur SIC-Herstellung Oriemical Vapour Deposition           Pulveraubreeitung         Mahltechnik           Sprühtrockner         3. Formgebung           Pressen (0. 15 %, Feuchte)         Gleefen (> 25 %, Feuchte)           Gleefen (> 25 %, Feuchte)         Plastische Formgebung           Pressen (0. 15 %, Feuchte)         Gleefen (> 25 %, Feuchte)           Binterstättig des Sinterns         Effekt von gekümmten Oberflächen und Diffusionswegen Sinterstättig des Sinterns           Effekt von gekümmten Oberflächen und Diffusionswegen         Sinterstättig des Sinterns           Herring scaling laws         Holfsisotalstiches Prossen           5. Mechanische Eigenschaften von Keramiken         Elastisches Ung plastisches Materialverhalton           Bruchzähigkeil - Linear-alastische Bruchmechanik         Festigkeil Steurentechanik           Festigkeil Steuren Keramische Materialeigenschaften Anwendungen         Keramische Ionenleiter           Indischaftsche Eigenschaften von Keramiken         Plezo, ferroolektrische Materialeigenschaften Anwendungen	СР	2
Language       DE/EN         SoSe       1. Einführung         Natürliche "Keramike" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vor Hochleistungskeramik         2. Pulverherstellung       Einteilung der Pulversynthessverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur Al2O3-Herstellung Chemical Vapour Deposition         Pulveraufbereitung       Mahltechnik Sprühtrockner         3. Formgebung       Arten der Formgebung Pressen (0 - 15 % Feuchte)         Patische Formgebung       Pressen (0 - 15 % Feuchte)         Plastische Formgebung       Pressen (0 - 15 % Feuchte)         Plastische Formgebung       Pressen (0 - 15 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)       Plastische Formgebung (15 - 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)       Plastisches Sintems Effekt von gekrümmten Oberllächen und Diffusionswegen Sinterstächen des isothermen Festphasensinterns Heirring scaling laws Heißikostalisches Pressen       5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten Bruchzähigkeit - Festigkeitsstreuung       6. Elektrische Eigenschaften von Keramiken         Ferroelektische Keramiken       Ferroelektische Keramiken         Ferroelektische Keramiken       Piezo-, ferroelektische Materialeigenschaften Anwendungen         Keramische lonenleiter       Ionische Leitfähigkeit	Language         DE/EN           Cycle         SoSe           1. Einführung           Natürliche "Keramiken" - Steine "Könstliche" Keramiken" - Vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverhorstellung           Einteilung der Pulversyntheseverfahren Der Rayen-Prozess zur Al203-Herstellung           Der Acheson-Prozes zur SUC-Herstellung           Chamical Vapour Deposition           Pulveraufbereitung           Mahliechnik           Sprühtrockner           3. Formgebung           Pressen (015 % Ereuchte)           Plastische Formgebung           Pressen (25 % Feuchte)           Plastische Formgebung (15 - 25 % Feuchte)           Plastische Sinterins           Effekt von gekrümmten Cobertlächen und Diffusionswegen           Sinterställen des isinterins           Effekt von gekrümten Cobertlächen von Keramiken           Elastisches und plastisisches Materialiverhalten		
Cycle         SoSe           1. Einführung         Natürliche Jeramiken" - Steine           "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik         Anwendungen vor Hochleistungskeramik           2. Pulverherstellung         Einteilung der Pulversyntheseverfahren           Der Bayer-Prozess zur Al2O3-Herstellung         Der Acheson-Prozess zur SiC-Herstellung           Der Acheson-Prozess zur SiC-Herstellung         Chemical Vapour Deposition           Pulveraufbereitung         Mahltechnik           Sprühtrockner         3. Formgebung           Arten der Forngebung         Pressen (0 - 15 % Feuchte)           Gießen (> 25 % Feuchte)         Piessische Formgebung (15 - 25 % Feuchte)           Vontent         4. Sintern           Triebkraft des Sinterns         Effekt von gekrümmten Oberflächen und Diffusionswegen           Sinterstadien des isothermen Festphasensinterns         Heriffisostatlisches Pressen           5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten           Bruchzähigkeit - Linea-leätsische Bruchmechanik         Festigkeit - Festigkeitstreuung           6. Elektrische Keramiken         Ferroelektische Keramiken           Fierroelektische Keramiken         Ferroelektische Keramiken           Fierroelektische Keramiken         Fierroelektische Keramiken           Fierroelektische Keramiken <th>Oycle         SoSe           1. Einführung         Natürliche "Keraniken" - Steine "Künstliche" Keraniken" - vom Porzellan bis zur Hochleistungskeranik Anwendungen v Hochleistungskeranik           2. Pulverherstellung         Einfallung der Pulversyntheseverfahren Der Bayer-Prozess zur XI203-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Ochemical Vapur Deposition           Pulveraufbereitung         Mahtechnik Sprühtrockner           3. Formgebung Pressen (0 - 15 % Feuchle)         Gieben (&gt; 25 % Feuchle)           Otenett         4. Sintern           Triebkraft des Sintens Effekt von gekrümmten Oberlächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws           Heiflörsdätisches Pressen         5. Mechanische Eigenschalten von Keramiken           Eissische und plastischer Bruser-teisphasensinterns Herring scaling laws           Heiflörsdätisches Pressen         5. Mechanische Eigenschalten von Keramiken           Eissisches und plastischer Bruser-teisphasensinterns Herring scaling laws           6. Elektrische Eigenschalten von Keramiken           Ferroelektische Karamiken           Paroelektische Karamiken           Paroelektische Karamiken           Piezo-, forroelektische Materialegenschaften Anwendungen           Keramische Ionenleiter           Datiertes Zirkonoxid in der Brennstoffzeile und Lambdasonde           D A H Jones, Michael F. Ashby, Engineering Materials 1</th> <th>Lecturer</th> <th>Prof. Gerold Schneider, Prof. Bodo Fiedler</th>	Oycle         SoSe           1. Einführung         Natürliche "Keraniken" - Steine "Künstliche" Keraniken" - vom Porzellan bis zur Hochleistungskeranik Anwendungen v Hochleistungskeranik           2. Pulverherstellung         Einfallung der Pulversyntheseverfahren Der Bayer-Prozess zur XI203-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Ochemical Vapur Deposition           Pulveraufbereitung         Mahtechnik Sprühtrockner           3. Formgebung Pressen (0 - 15 % Feuchle)         Gieben (> 25 % Feuchle)           Otenett         4. Sintern           Triebkraft des Sintens Effekt von gekrümmten Oberlächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws           Heiflörsdätisches Pressen         5. Mechanische Eigenschalten von Keramiken           Eissische und plastischer Bruser-teisphasensinterns Herring scaling laws           Heiflörsdätisches Pressen         5. Mechanische Eigenschalten von Keramiken           Eissisches und plastischer Bruser-teisphasensinterns Herring scaling laws           6. Elektrische Eigenschalten von Keramiken           Ferroelektische Karamiken           Paroelektische Karamiken           Paroelektische Karamiken           Piezo-, forroelektische Materialegenschaften Anwendungen           Keramische Ionenleiter           Datiertes Zirkonoxid in der Brennstoffzeile und Lambdasonde           D A H Jones, Michael F. Ashby, Engineering Materials 1	Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition         Pulveraufbereitung         Mahltechnik Sprühtrockner         3. Formgebung         Arten der Forngebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte)         Die Basche Forngebung Pressen (0 - 15 % Feuchte)         Gießen (> 25 % Feuchte)         Plastische Forngebung         Arten der Forngebung Pressen (0 - 15 % Feuchte)         Dießen (> 25 % Feuchte)         Bistische Forngebung         Pressen (1 - 15 % Feuchte)         Gießen (> 25 % Feuchte)         Plastische Forngebung         Pressen (0 - 15 % Feuchte)         Gießen (> 25 % Feuchte)         Binterstadien des isothermen Festphasensinterns Herring scaling laws         Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitserberung         6. Elektrische Eigenschaften von Keramiken         Fiezo., ferroelektische Materialeigenschaften Anwendungen         Ferroelektrische Materialeigenschaften An	1. Einführung         Natürliche, Keramiken*-Steine         "Künstliche* Keramik       - vom Porzellan bis zur Hochleistungskeramik       Anwendungen v         Jehreistungskeramik       - vom Porzellan bis zur Hochleistungskeramik       Anwendungen v         Jehreistellung       Einteilung der Pulversyntheseverfahren       Der Bayer-Prozess zur AEQ3-Herstellung         Der Acheson-Prozess zur SCI-Herstellung       Chemical Vapour Deposition       Pulveraufbereitung         Mahltechnik       Sprührockner       3. Formgebung         Arten der Formgebung       Pressen (0 15 % Feuchte)       Gel86n (- 25 % Feuchte)         Ceitem 4. Sintern       Treibkraft des Sinterns       Effekt von gekümmten Oberflächen und Difusionswegen         Sinterstadien des isothermen Festphasensinterns       Helfäsostatisches Pressen       5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten       Bruchzängkeit - Lineer-leastelsche Bruchmechanik       Festigkeit-serkeiten eigenschaften         6. Elektrische Eigenschaften von Keramiken       Feroelektische Materialigenschaften       Anwendungen         Keramische lonenleiter       Ionische Leittähigkeit       Dotientes Zirkonoxid in der Brennstoffzeile und Lambdasonde         0 R. H. Jones, Michael F. Astby, Engineering Materials 1, An Introduction to Properties, Applicatic and Design, Elesevier       D.W. Richerson, Modem Ceramics, John Wiley & Sons, New York, 1992	Language	DE/EN
Natürliche "Feramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen va Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bagver-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Chemical Vapour Deposition         Pulveraufbereitung         Mahltechnik         Sprühtrockner         3. Formgebung         Pressen (0 - 15 % Feuchte)         Gießen (> 25 % Feuchte)         Gießen (> 25 % Feuchte)         Gießen (> 25 % Feuchte)         Sinterns         Effekt von gekrümmten Oberllächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Hering scaling laws         Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Muterialtverhalten Bruchzähigkeit - Festigkeitstreuung         6. Elektrische Eigenschaften von Keramiken         Ferroelektische Keramiken         Fiezo-, ferroelektrische Materialeigenschaften Anwendungen	Natürliche Keramiken* - Steine "Künstliche* Keramik - vom Porzellan bis zur Hochleistungskeramik       Anwendungen v Hochleistungskeramik         2. Pulverherstellung       Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur AI2O3-Herstellung Der Acheen-Prozes zur SIG-Herstellung         Der Abenen-Prozes zur SIG-Herstellung       Pulveraufbereitung         Mahltechnik       Sprühtrockner         3. Formgebung       Arten der Formgebung Pressen (0 - 15 % Feuchle)         Resen (- 25 % Feuchle)       Resen (- 25 % Feuchle)         Plassische Formgebung (15 - 25 % Feuchle)       Refet von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Heritig szelling laws Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken       Elastische Sinterns Elekt von elastische Bruchmechanik Festigkeit - Linear elastische Bruchmechanik Festigkeit - Festigkeitisstreuung         6. Elektrische Eigenschaften von Keramiken       Festigkeit Eigenschaften von Keramiken         Festigkeit - Festigkeitisstreuung       S. Elektrische Keramiken         Piezo-, ferroelektische Katernäleigenschaften Anwendungen       Keramische lonenleiter         Ionische Leitfähigkeit       Dotiertes Zirkonoxidi in der Brennstoffzelle und Lambdasonde         D.W. Richerson, Modern Geramic Engineering, Marcel Decker, New York, 1992       W.D. Kingery, Introduction to Ceramics. John Wiley & Sons, New York, 1975         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre	Cycle	SoSe
	and Design, Elesevier D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre 1998		1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vol Hochleistungskeramik         2. Pulverherstellung         Einfeilung der Pulversyntheseverlahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SIC-Herstellung Chemical Vapour Deposition Pulveraufbereitung         Mahltechnik Sprühtrockner         3. Formgebung         Arten der Formgebung Pressen (0 - 15 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte)         4. Sintern         Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elastisches und plastische Staterialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung         6. Elektrische Eigenschaften von Keramiken         Ferroelektische Keramiken         Fiezo-, ferroelektische Materialeigenschaften Anwendungen         Keramische Ionenleiter         keramische Ionenleiter
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre 1998		D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	1998		W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D. Munz, T. Fett, Ceramics, Springer, 2001		D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres 1998
W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres			D. Munz, T. Fett, Ceramics, Springer, 2001



Ha	ruktur und mechanische Eigenschaften G.W.Ehrenstein; anser Verlag; ISBN 3-446-12478-0; ca. 20 € unststoffphysik
We G.M Kur	. Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 € /erkstoffkunde Kunststoffe .Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 € unststoff-Kompendium Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

Course L1234: Enhance	Course L1234: Enhanced Fundamentals: Ceramics and Polymers	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1086: Enhance	ourse L1086: Enhanced Fundamentals: Metals		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Jörg Weißmüller, Prof. Patrick Huber		
Language	DE		
Cycle	SoSe		
Content	Enhanced Fundamentals of Metals:   Introduction to phenomenological thermodynamics Elasticity  Thermal materials behavior (heat capacity, thermal expansion) Conductors, semiconductors, isolators: conduction mechanisms and band structure Superconductors Dry corrosion Electrochemistry in the material sciences Wet corrosion Alloy corrosion Corrosion protection Stainless steel Battery materials Supercapacitors Fuel cells Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism Magnetic materials: applications		
Literature	Vorlesungsskript		



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management (L0880)		<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (Lu	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most importar aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, informatio management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business unit strategies etc.) and to carry out an Entrepre analyse Management goals and stru- analyse organisational and staff stru- apply methods for decision making analyse production and procurement analyse and apply basic methods or select and apply basic methods from apply basic methods from accounting	neurship project in a team. In project in a team. In project in a team. In projecture them appropriately inclures of companies under multiple objectives, under the systems and Business inform f marketing in mathematical finance to prede	articular, the r uncertainty ation system	y are able to and under risissems
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the t</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time ir	Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	·			



and scale	I			
and scale	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Computer Science: Compulsory			
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Eloprocess Engineering, Computering General Engineering Science (German program): Specialisation Energy and Environmenta			
	Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Civil- and Enviromenta			
	Engeneering: Compulsory			
	General Engineering Science (German program): Specialisation Mechanical Engineering			
	Compulsory			
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science			
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering			
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering			
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and			
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering			
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering			
	Focus Product Development and Production: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering			
	Focus Energy Systems: Compulsory			
	Civil- and Environmental Engineering: Core qualification: Compulsory			
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory			
Accimment for the				
Assignment for the Following Curricula				
I ollowing our licula	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Energy and Enviromenta			
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory			
	General Engineering Science (English program): Specialisation Computer Science: Computering: Com			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory			
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering			
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture			
	15001			

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core gualification: Compulsory
 Process Engineering: Core gualification: Compulsory



Tvn	Lecture
Hrs/wk	
CP	
	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	
	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateginformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>



Course L0882: Project E	intrepreneurship
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



## **Focus Theoretical Mechanical Engineering**

The graduates acquire basic research and methodological oriented content mechanical engineering knowledge and associated mechanical engineering expertise to develop mathematical descriptions, analysis and synthesis of basic technical systems methods, products or processes. This course, concentrates on simulation technology, advanced mathematics and heat transfer, such that a continuous study in the Master program in Theoretical Mechanical Engineering is possible.

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir Advanced Mechanical Engir		Recitation Section (large) Lecture	2 2	1 2
Advanced Mechanical Engir		Recitation Section (large)	2	-
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solving skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Tin	ne in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	100			

	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: 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 Materials in Engineering Sciences: 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: Compulsory
	Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Assignment for the Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Ū.	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Declarate Development and Production: Compulsory
	Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



Course L0264: Advance	d Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II
Content	Lecture
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0265: Advanced Mechanical Engineering Design II		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
	Advanced Mechanical Engineering Design I & II
Content	Lecture
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



Course L0263: Advance	ourse L0263: Advanced Mechanical Engineering Design I		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
<b>Title</b> Signals and Systems (L0432	2)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Signals and Systems (L043)		Recitation Section (large)	3 1	4 2
Module Responsible				
Admission				
Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is exp (Fourier series, Fourier transform, Laplace transform, Lapl	pected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describ methods of signal and system theory. They continuous-time and discrete-time signals an signals and systems mathematically in both ti effects in time domain and image domain w signal to a discrete-time signal.	r are able to apply the fund d systems. They can describe me and image domain. In par	amental trai e and analys ticular, they	nsformations of se determinist understand th
Skills	The students are able to describe and analys using methods of signal and system theory. important properties such as magnitude and the impact of LTI systems on the signal proper	They can analyse and design phase response, stability, line	n basic sys earity etc T	tems regardin
Personal Competence				
Social Competence	The students can jointly solve specific problem			
Autonomy	The students are able to acquire relevant in control their level of knowledge during the le clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German Engeneering: Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra	am): Specialisation Computer am): Specialisation Process E am): Specialisation Bioproces program): Specialisation program): Specialisation am): Specialisation Biomedica ram, 7 semester): Specialisa gram, 7 semester): Specialisa	Science: Co ingineering: is Engineerin Civil- and Mechanical al Engineerin tion Electric isation Corr ation Proces	ompulsory Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering oputer Science



	Concercipe Cristian Colonian (Correspondence), Concerciption Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	
Ū	General Engineering Science (English program). Specialisation Givin- and Environmental Engeneering.
	Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Ochiputer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



J.	nd Systems		
Тур	Lecture		
Hrs/wk			
СР			
	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Gerhard Bauch		
	SoSe		
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>		
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



ourse L0433: Signals and Systems	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Τ	/n	Hre/wk	СР
-	-	3	4
		2	2
Dr. Andreas Moschallski			
None			
Technical Thermodynamics I, II and Fluid Dynamics			
After taking part successfully, students have reached	the following learning	n results	
		groound	
The students are able to			
- describe the different physical mechanism of Heat T	ransfer,		
- explain the technical terms,			
- to analyse comlex heat transfer processes in a critic	al way.		
The students are able to			
- understand the physics of Heat Transfer,			
- calculate and evaluate complex Heat Transfer processes,			
- solve excersises self-consistent and in small groups	S.		
The students are able to discuss in small groups and develop an approach.			
The students are able to develop a complex problem self-consistent and analyse the results in critical way. A qualified exchange with other students is given.			
Independent Study Time 110. Study Time in Lecture	70		
6			
6			
6 Written exam	Specialisation Mecl	nanical Engir	neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory			
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program):			
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory	Specialisation Mech	nanical Engir	neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program):	Specialisation Mecl	hanical Engir cal Engineerir	neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program): Sp	Specialisation Mecl ecialisation Biomedic Specialisation Mecl	hanical Engir cal Engineerir hanical Engir	neering, Foc ng: Compulso neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 sc	Specialisation Mecl ecialisation Biomedic Specialisation Mecl	hanical Engir cal Engineerir hanical Engir	neering, Foc ng: Compulso neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program): Sp	Specialisation Mecl ecialisation Biomedic Specialisation Mecl emester): Specialisati	nanical Engir cal Engineerir nanical Engir ion Mechanica	neering, Foc ng:Compulso neering, Foc al Engineerin
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 se Focus Energy Systems: Compulsory General Engineering Science (German program, 7 se Focus Energy Systems: Compulsory General Engineering Science (German program, 7 se Focus Theoretical Mechanical Engineering: Compulsory	Specialisation Mecl ecialisation Biomedic Specialisation Mecl emester): Specialisati emester): Specialisati	hanical Engir cal Engineerir hanical Engir ion Mechanica	neering, Foci ng: Compulso neering, Foci al Engineerin al Engineerin
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6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Theoretical Mechanical Engineering: Compuls General Engineering Science (German program, 7 sc Focus Theoretical Mechanical Engineering: Compuls General Engineering Science (German program, 7 sc Compulsory	Specialisation Mech ecialisation Biomedia Specialisation Mech emester): Specialisati emester): Specialisati sory emester): Specialisati	hanical Engir cal Engineerir hanical Engir ion Mechanica ion Mechanica	neering, Foc ng: Compulso neering, Foc al Engineerin al Engineerin al Engineerin
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6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Theoretical Mechanical Engineering: Compuls General Engineering Science (German program, 7 sc Compulsory General Engineering Science (English program): Spe General Engineering Science (English program): Biomechanics: Compulsory General Engineering Science (English program):	Specialisation Mech ecialisation Biomedio Specialisation Mech emester): Specialisati emester): Specialisati sory emester): Specialisati ecialisation Biomedic Specialisation Mech	hanical Engir cal Engineerir hanical Engir ion Mechanica ion Mechanica ion Biomedica al Engineerin hanical Engir	neering, Foc ng: Compulso neering, Foc al Engineerir al Engineerir al Engineerir g: Compulso neering, Foc
6 Written exam 120 min General Engineering Science (German program): Biomechanics: Compulsory General Engineering Science (German program): Energy Systems: Compulsory General Engineering Science (German program): Sp General Engineering Science (German program): Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Energy Systems: Compulsory General Engineering Science (German program, 7 sc Focus Theoretical Mechanical Engineering: Compuls General Engineering Science (German program, 7 sc Focus Theoretical Mechanical Engineering: Scompuls General Engineering Science (English program): Spe General Engineering Science (English program): Spe General Engineering Science (English program): Spe	Specialisation Mech ecialisation Biomedio Specialisation Mech emester): Specialisati emester): Specialisati sory emester): Specialisati ecialisation Biomedic Specialisation Mech	hanical Engir cal Engineerir hanical Engir ion Mechanica ion Mechanica ion Biomedica al Engineerin hanical Engir hanical Engir	neering, Foc ng: Compulso neering, Foc al Engineerir al Engineerir g: Compulso neering, Foc neering, Foc
	Le Re Dr. Andreas Moschallski None Technical Thermodynamics I, II and Fluid Dynamics After taking part successfully, students have reached The students are able to - describe the different physical mechanism of Heat T - explain the technical terms, - to analyse comlex heat transfer processes in a critic The students are able to - understand the physics of Heat Transfer, - calculate and evaluate complex Heat Transfer proce - solve excersises self-consistent and in small groups and The students are able to discuss in small groups and The students are able to develop a complex prob	None Technical Thermodynamics I, II and Fluid Dynamics After taking part successfully, students have reached the following learning The students are able to - describe the different physical mechanism of Heat Transfer, - explain the technical terms, - to analyse comlex heat transfer processes in a critical way. The students are able to - understand the physics of Heat Transfer, - calculate and evaluate complex Heat Transfer processes, - solve excersises self-consistent and in small groups. The students are able to discuss in small groups and develop an approact The students are able to develop a complex problem self-consistent a critical way. A qualified exchange with other students is given.	Lecture       3         Pr. Andreas Moschallski         None         Technical Thermodynamics I, II and Fluid Dynamics         After taking part successfully, students have reached the following learning results         The students are able to         - describe the different physical mechanism of Heat Transfer,         - explain the technical terms,         - to analyse comlex heat transfer processes in a critical way.         The students are able to         - understand the physics of Heat Transfer,         - calculate and evaluate complex Heat Transfer processes,         - solve excersises self-consistent and in small groups.         The students are able to discuss in small groups and develop an approach.         The students are able to develop a complex problem self-consistent and analyse the critical way. A qualified exchange with other students is given.



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Course L0458: Heat Transfer			
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Dr. Andreas Moschallski		
Language	DE		
Cycle	WiSe		
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfe (evaporation, condensation), thermal radiation, heat exchangers, measurement methods		
<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesba 2014</li> <li>Literature</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, B Heidelberg, 1996</li> </ul>			

Course L0459: Heat Transfer	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title		Тур	Hrs/wk	СР
Production Engineering I (L0	0608)	Lecture	2	2
Production Engineering I (L0		Recitation Section (large)	1	1
Production Engineering II (Lo	0610)	Lecture	2	2
Production Engineering II (L	0611)	Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
_	no course assessments required			
	Recommended evious Knowledge internship recommended			
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional				
Competence				
	Students are able to			
Knowledge	<ul> <li>name basic criteria for the selection of manufacturing processes.</li> <li>name the main groups of Manufacturing Technology.</li> <li>name the application areas of different manufacturing processes.</li> <li>name boundaries, advantages and disadvantages of the different manufacturing process.</li> <li>describe elements, geometric properties and kinematic variables and requirements for tools workpiece and process.</li> <li>explain the essential models of manufacturing technology.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>select manufacturing processes in accordance with the requirements.</li> <li>design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.</li> <li>assess components in terms of their production-oriented construction.</li> </ul>			
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>develop solutions in a production environment with qualified personnel at technical level an represent decisions.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>interpret independently the manufacturing process.</li> <li>assess own strengths and weaknesses in general.</li> <li>assess their learning progress and define gaps to be improved.</li> <li>assess possible consequences of their actions.</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points		··· ·		
	Written exam			
Examination duration and scale				



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 General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory
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Course L0608: Production	on Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
Literature	<ul> <li>Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007</li> <li>Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004</li> <li>Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen moderne Messverfahren. Wiesbaden : Teubner, 2008</li> <li>Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008</li> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)</li> <li>Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006</li> <li>Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996</li> <li>Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)</li> </ul>

Course L0612: Production Engineering I		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

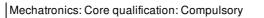


Course L0610: Production	on Engineering II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Geometrically undefined machining (grinding, lapping, honing)</li> <li>Introduction into erosion technology</li> <li>Introduction into blastig processes</li> <li>Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites)</li> <li>Fundamentals of Laser Technology</li> <li>Process versions and Fundamentals of Laser Joining Technology</li> </ul>
Literature	<ul> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005)</li> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung.</li> <li>4. Aufl., Springer (2007)</li> <li>Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.] : Hanser, 1981</li> <li>Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007</li> </ul>

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



Courses					
Title Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2	
Module Responsible					
Admission Requirements					
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory	v and electrical engineering			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results		
Professional Competence	Students are able to describe methods	and calculations for design,	modeling,	simulation a	
	Students are able to apply modern algorith	optimization of mechatronic systems. Students are able to apply modern algorithms for modeling of mechatronic systems. They can ident simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence					
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups				
Autonomy	Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define further course of study.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Examination Examination duration	Written exam 90 min				
and scale			·	· _	
	General Engineering Science (German p Mechatronics: Compulsory General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Aircraft Systems Engineering: Comp General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (English p Aircraft Systems Engineering: Compulsory General Engineering Science (English p Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Aircraft Systems Engineering: Comp General Engineering Science (English pro Focus Theoretical Mechanical Engineering Mechanical Engineering: Specialisation Air Mechanical Engineering: Specialisation Th	program): Specialisation Mecha program): Specialisation Mecha pulsory gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation corogram): Specialisation Mecha program): Specialisation Mecha program, 7 semester): Specialisation gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation : Elective Compulsory craft Systems Engineering: Com protechatronics: Compulsory	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foo neering, Foo cal Engineerin cal Engineerin cal Engineerin neering, Foo neering, Foo cal Engineerin cal Engineerin cal Engineerin	



Course L1822: Simulation and Design of Mechatronic Systems			
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Weltin		
Language	DE		
Cycle	WiSe		
Content	Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab <sup>®</sup> and Simulink <sup>®</sup>		
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung		

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

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



Courses				
Title Advanced Mechanical Design Project (L0266)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements				
Recommended Previous Knowledge	<ul><li>Mechanical Engineering: Design</li><li>Advanced Mechanical Engineering</li></ul>	Design		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence	After passing the module, students are able	to:		
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>express the procedure for systematically handling of</li> <li>complex design tasks ,</li> <li>describe working principles, their use and combination possibilities,</li> <li>explain guidelines for designing for function and manufacturing,</li> <li>explain advanced use-oriented knowledge of machine elements.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able</li> <li>analyze complex tasks and develop</li> <li>convert principle solutions into a det</li> <li>use methods to design and solve oriented,</li> <li>create a technical documentation in functions of the system,</li> <li>document calculations of selected methods</li> </ul>	principle solutions using sketch ailed design, e engineering design tasks s cluding all necessary technical	ystematicall drawings to	-
Personal Competence				
Social Competence	After passing the module, students are able to:			
Autonomy	<ul> <li>After passing the module, students are able to:</li> <li>independently solve complex design projects, while motivating themselves, acquirir necessary knowledge and selecting appropriate methods,</li> <li>to independently solve problems.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Com General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German pro- Focus Aircraft Systems Engineering: Comp General Engineering Science (German pro- Focus Product Development and Production	program): Specialisation Mech ipulsory program): Specialisation Mech iulsory gram, 7 semester): Specialisatio ulsory gram, 7 semester): Specialisatio	anical Eng anical Eng on Mechanic	ineering, Focu ineering, Focu cal Engineerin



Assignment for the<br/>Following CurriculaGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Product Development and Production: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Aircraft Systems Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Product Development and Production: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>Mechanical Engineering: Compulsory<br/>Mechanical Engineering: Compulsory

Course L0266: Advance	d Mechanical Design Project			
Тур	Project-/problem-based Learning			
Hrs/wk	۱ ۱			
CP				
Workload in Hours	ndependent Study Time 124, Study Time in Lecture 56			
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen			
Language	DE			
Cycle	WiSe			
	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.			
Content	<ul> <li>Getriebekonstruktion in Einzelarbeit         <ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> </ul> </li> <li>Lösungsfindung         <ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul> </li> </ul>			
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>			

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Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L032	24)	Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	The successful completion of the labs will be honored during the evaluation of the module examination according to the following rules:			
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional				
Competence				
	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone of	or in a group and to prese	ent the result	s accordingly
Autonomy	Students are able to acquire new knowledge from with other classes.	specific literature and to	o associate t	his knowledç
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points				
Examination				
Examination duration				
and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Core qualification: Compulsory
Following Curricula	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Engineering			
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer Engineering		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-				_
Module Responsible				
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 ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain arr implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	intly solve technical problems, a	and experim	entally validat
Autonomy	Students can obtain information from provided sources (lecture notes, software documentatio 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				
	Written exam			
Examination duration and scale	120 mih			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core qualification: Compulsory

	Lecture
Hrs/wk CP	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Content	WiSe         Signals and systems            Linear systems, differential equations and transfer functions             First and second order systems, poles and zeros, impulse and step response             Stability          Feedback systems             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             Root locus techniques             Root locus design of PID controllers             Root locus design of PID controllers             Frequency response techniques             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             Time delay systems             Root locus and frequency response of time delay systems             Smith predictor          Digital control             Sampled-data systems
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
<b>Title</b> Differential Equations 2 (Part	ial Differential Equations) (L1043) ial Differential Equations) (L1044)	<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 1
Differential Equations 2 (Part Complex Functions (L1038)	ial Differential Equations) (L1045)	Recitation Section (large)	1 2	1 1
Complex Functions (L1041) Complex Functions (L1042)		Recitation Section (small) Recitation Section (large)	1 1	1
Module Responsible Admission				
Requirements Recommended	None			
Previous Knowledge	Mathematics 1 - III			
-	After taking part successfully, students ha	ave reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them usin appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in the course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.</li> </ul>		neir cooperating	
Autonomy	<ul> <li>Students are capable of checking can specify open questions precis</li> <li>Students have developed sufficie oriented manner on hard problem</li> </ul>	sely and know where to get help in ant persistence to be able to work	n solving the	m.
Workload in Hours	Independent Study Time 68, Study Time	in Lecture 112		
Credit points	6			
Examination	Written exam			

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus



	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	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 Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering. Compulsory
	General Engineering Science (English program): Specialisation Mavar Methicelate: Comparisory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Assignment for the	Mechatronics: Compulsory
0	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
i olioting our louid	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Mechanical Engineering: Specialisation Mechatronics: 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)			
	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle			
Content	<ul> <li>Main features of the theory and numerical treatment of partial differential equations</li> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		

Course L1044: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (small)
Hrs/wk	1
СР	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

Тур	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		
Тур	ecture		
Hrs/wk			
СР			
Workload in Hours	ndependent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		

Түр	Recitation Section (small)
Hrs/wk	
СР	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

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Module M0829: Fo	undations of Management			
Courses				
Title	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 3
Project Entrepreneurship (L0882)		Project-/problem-based Learning	2	3
Module Responsible	-			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	After taking this module, students know the			
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations unde multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>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 <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods for marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time ir	n Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	]
and Scale	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor
	General Engineering Science (German program): Specialisation Energy and Enviromenta
	Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering
Following Curricula	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Energy and Enviromenta
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Computer Science. Computering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture
	Constar Engineering Osence (English program, 7 semesier). Specialisation Navai Alchilecture
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	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
<u> </u>	Process Engineering: Core qualification: Compulsory



Tvn	Lecture		
Hrs/wk			
CP			
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateginformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>		



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



# **Specialization Biomedical Engineering**

The requirements into the health system increase continuously due to the aging population and the increasing expectations for the quality in life. A major aspect in this development is medical technology. This ranges from individual implants and prostheses to complex imaging and therapy equipment and its operation. Medical specialists and well educated engineers will have to cooperate closer and closer to understand the requirements from either side and develop solutions together. In order to cooperate, the engineers need in addition to their core engineering skills, a basic understanding of the "other" fields, which are Medicine and Economy. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area. The program is aimed towards allowing the students to achieve these qualifications.

## Module M0933: Fundamentals of Materials Science

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S	Science I (L1085)	Lecture	2	2
Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	<sup>d</sup> Lecture	2	2
1 , ( )	cs 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				
Knowledge	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.			
Skills	The students are able to trace materials phenor laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosi solidification, precipitation, or melting. The stud conditions and the materials microstructure, and the material's behavior.	to mechanical properties ion resistance, and to pha dents can explain the re	s such as st ase transforr lation betwo	rength, ductilit mations such a een processin
Personal Competence				
Social Competence	-			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	100			
	General Engineering Science (German prog	gram): Specialisation E	Energy and	Enviroment



Assignment for the Following Curricula Following Curricula General Engineering Science (Egrish program): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program): Specialisation Naval Architecture: 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 Naval Architecture Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (English program): Specialisation Energy and Environmenta Engineering Science (English program): Specialisation Energy and Environmenta Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmenta Engineering: Compulsory Logistics and Mobility: Spe
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Course L1085: Fundamentals of Materials Science I			
Тур	Lecture		
Hrs/wk	2		
СР	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		



Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	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	nt 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	

Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	<ul> <li>Motivation: "Atoms in Mechanical Engineering?"</li> <li>Basics: Force and Energy</li> <li>The electromagnetic Interaction <ul> <li>"Detour": Mathematics (complex e-funktion etc.)</li> </ul> </li> <li>The atom: Bohr's model of the atom</li> <li>Chemical bounds</li> <li>The multi part problem: Solutions and strategies</li> <li>Descriptions of using statistical thermodynamics</li> <li>Elastic theory of atoms</li> <li>Consequences of atomar properties on makroskopic Properties: Discussion of example (metals, semiconductors, hybrid systems)</li> </ul>
Literature	<ul> <li>Für den Elektromagnetismus:</li> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", Gruyter</li> <li>Für die Atomphysik: <ul> <li>Haken, Wolf: "Atom- und Quantenphysik", Springer</li> </ul> </li> <li>Für die Materialphysik und Elastizität: <ul> <li>Hornbogen, Warlimont: "Metallkunde", Springer</li> </ul> </li> </ul>

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Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are liftec	examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence Knowledge Skills	<ul> <li>This module deals with the foundations of the fur from the assembly-level programming down to gate.</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean a combinational networks</li> <li>Sequential logic: Flip-flops, automata, syste</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subte</li> <li>Basics of computer architecture: Prograpipelining</li> <li>Memories: Memory hierarchies, SRAM, DF</li> <li>Input/output: I/O from the perspective of connections, busses</li> </ul> The students perceive computer systems from the structure and the physical composition of computer specific and individual computers can be built bathey are able to distinguish between and to computing systems - from gates and circuits up to After successful completion of the module, the between a physical computer system and the understand the consequences that the execution layers from the assembly language down to gatimpact that these low abstraction levels have of feasible options.	tes. The module includes algebra, Boolean funct ematic hardware design traction, multiplication and ramming models, MIPS RAM, caches the CPU, principles of p e architect's perspective, i uter systems. The studen ased on a collection of fe explain the different ab complete processors. students are able to jud software executed on of software has on the h tes. This way, they will b	the following ions, hardw d division single-cycle bassing data .e., they iden ts can analy w and simpl ostraction lay dge the inter it. In particu ardware-cen be enabled t	topics: are synthesis are synthesis are architecture , point-to-poin tify the interna ze, how highly e components rers of today's rdependencies lar, they shal tric abstraction o evaluate the
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate t	his knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory

#### TUHH Hamburg University of Technology

#### Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Engineering		
Тур	Lecture	
Hrs/wk		
СР	4	
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Computer Engineering	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



<b>Typ</b> Lecture Recitation Section (la	Hrs/wk 3 rge) 1	<b>CP</b> 4 2
theory of signals and systems 3 is expected. Further experien ace transform) is useful but not	ce with spectral	
have reached the following lea	ning results	
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.		
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.		
problems.		
The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system.		
me in Lecture 56		
program): Specialisation Elec		
n program): Specialisation Com n program): Specialisation Proc n program): Specialisation Biop erman program): Specialisat erman program): Specialisat erman program): Specialisation Bion n program, 7 semester): Spec an program, 7 semester): Specia n program, 7 semester): Specia n program, 7 semester): Specia n program, 7 semester): Specia	ess Engineering ocess Engineeri ion Civil- and ion Mechanica edical Engineeri alisation Electric ecialisation Cor ialisation Proce isation Bioproce isation Bioproce	Compulsory ing: Compulso Enviroment I Engineering ing: Compulso cal Engineering nputer Scienc ss Engineering ess Engineering cal Engineering
ı program, 7 semest	er): Speciai	er): Specialisation Mechan



	Consul Engineering Science (Correspondence 7 consister), Specialization Machanical Engineering
	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory
Assignment for the	
Following Curricula	Licensal Engineering. One quanication. Compusory
•	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory



ourse L0432: Signals and Systems		
Typ Lecture		
Hrs/wk	3	
СР	4	
	Independent Study Time 78, Study Time in Lecture 42	
	Prof. Gerhard Bauch	
Language		
Cycle	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>	
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubne Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>	



Course L0433: Signals and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses			
Title	Тур	Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)	Lecture Recitation Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung		
Admission Requirements	None		
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics and	d thermodyn	amics.
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge	Students will have the required sound knowledge to explain the general pri and physics of fluids. Students can scientifically outline the rationa mathematical models and are familiar with methods for the performance an fluid engineering devices.	le of flow	physics usir
Skills	Students are able to apply fluid-engineering principles and flow-physics technical systems. The lecture enables the student to carry out all necess for the fluid dynamic design of engineering devices on a scientific level.	models for ary theoreti	the analysis cal calculation
Personal Competence			
Social Competence	The students are able to discuss problems and jointly develop solution strat	tegies.	
Autonomy	The students are able to develop solution strategies for complex problems analyse results.	self-consist	ent and crtica
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Examination	Written exam		
Examination duration and scale	180 min		
	General Engineering Science (German program): Specialisation Compulsory General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Naval Arch General Engineering Science (German program, 7 semester): Specialisatio Compulsory General Engineering Science (German program, 7 semester): Specialisatio Compulsory	al Engineerin hitecture: Co on Mechanic on Biomedic	ng: Compulsc ompulsory al Engineerin

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### Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0454: Fluid Mechanics			
Тур	Lecture		
Hrs/wk			
СР			
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42		
Lecturer	rof. Thomas Rung		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Overview</li> <li>Physical/mathematical modelling</li> <li>Special phenomena</li> <li>Basic equations of fluid dynamics</li> <li>The turbulence problem</li> <li>One dimensional theory for inkompressibel flows</li> <li>One dimensional theory for kompressibel flows</li> <li>Flow over contours without friction</li> <li>Flow over contours with friction</li> <li>Flow through channels</li> <li>Simplified equations for three dimensional flow</li> <li>Special aspects of the numerical solution for complex flows</li> </ul>		
Literature	<ul> <li>Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006</li> <li>Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004</li> </ul>		

ourse L0455: Fluid Mechanics	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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Module M0960: N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Mechanics	Multibody
oystems)		
Courses		
Title	Typ Hrs/wk	СР
(L1137)	Oscillations, Analytical Mechanics, Multibody Systems) Lecture 3	3
(LII30)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small) 2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) 1	1
Module Responsible		
Admission Requirements	None	
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional		
Competence		
	The students can	
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>	
	The students can	
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formatio and apply it to the context of their own problems;</li> <li>apply basis methods to applicating problems;</li> </ul>	
Personal Competence		
Social Competence	The students can work in groups and support each other to overcome difficulties.	
	Students are capable of determining their own strengths and weaknesses and to organize their tim and learning based on those.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	
Credit points		
	Written exam	
Examination duration and scale	120 min	
	General Engineering Science (German program): Specialisation Mechanica	I Engineering
	Compulsory	
	General Engineering Science (German program): Specialisation Biomedical Engineeri General Engineering Science (German program): Specialisation Naval Architecture: Co General Engineering Science (German program, 7 semester): Specialisation Mechanic Compulsory	ompulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedia Compulsory	al Engineerin
	General Engineering Science (German program, 7 semester): Specialisation Nav Compulsory	al Architectur
Assignment for the Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineeri General Engineering Science (English program): Specialisation Biomedical Engineerin General Engineering Science (English program): Specialisation Naval Architecture: Co	ng: Compulsor mpulsory
		-



Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Core qualification: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
 Compulsory

Тур	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	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
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) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L1138: Mechanic	rse L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Robert Seifried		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Course L1139: Mechani	urse L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	
Тур	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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1277: ME	ED I: Introduction to Anatomy	/		
Courses				
Title Introduction to Anatomy (L03	384)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Udo Schumacher			
nequirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students	have reached the following le	arning results	
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeleta system. The students can describe the basic macroscopy and microscopy of those systems.		nusculoskeletal	
Skills	The students can recognize the relationship between given anatomical facts and the development or some common diseases; they can explain the relevance of structures and their functions in the contex of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in curr professional level.	ent discussions in biomedic	al research and	medicine on a
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquire the relevant knowledge themselves.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination				
Examination duration and scale	90 minutes	90 minutes		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation III. Engineering Science: Elective Compulsory			



Course L0384: Introduct	tion to Anatomy
Тур	
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange
Language	DE
Cycle	SoSe
Content	8 <sup>th</sup> week:       Immune system         9 <sup>th</sup> week:       Digestive System I         10 <sup>th</sup> week:       Digestive System II         11 <sup>th</sup> week:       Endocrine System
	12 <sup>th</sup> week: Nervous System 13 <sup>th</sup> week: Exam
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012



ourses				
itle		Tun	Hrs/wk	СР
	d Radiation Therapy (L0383)	<b>Typ</b> Lecture	2	3
Module Responsible	Prof Ulrich Carl			
Admission				
Requirements	None			
Recommended	None			
Previous Knowledge	After taking part augagesfully, student	a have reached the following I		
Educational Objectives Professional	After taking part successfully, student	s have reached the following i	earning results	
Competence				
	Therapy			
	The students can distinguish differe radiation therapy.	nt types of currently used ec	uipment with respe	ect to its use
	The students can explain treatment psurgery, internal medicine).	plans used in radiation therap	oy in interdisciplinar	ry contexts (e
	The students can describe the patie care.	ents' passage from their initi	al admittance throu	igh to follow-
	Diagnostics			
Knowledge	The students can illustrate the te angiography and mammography, as			
	The students can explain the diagno the technical basis for those techniqu	stic as well as therapeutic use		
	The students can choose the right tr		on the patient's clin	ical history a
	The student can explain the influence	e of technical errors on the ima	ging techniques.	
	The student can draw the right con protocol.	clusions based on the image	es' diagnostic findin	igs or the er
	<b>Therapy</b> The students can distinguish curativ conclusion.	e and palliative situations ar	nd motivate why the	ey came to the
	The students can develop adequate t	herapy concepts and relate it	to the radiation biolo	gical aspect
	The students can use the therapeutic	principle (effects vs adverse e	effects)	
	The students can distinguish differer situation (location of the tumor) and c			
Skills	The student can assess what an in treatment, sports, social help groups,			
	Diagnostics			,
	The students can suggest solutions analyses.	for repairs of imaging instru	mentation after hav	<i>r</i> ing done er
	The students can classify results of based on their knowledge of anatomy			ps of diseas
Personal Competence				
•	The students can assess the specia	al social situation of tumor pa	atients and interact	with them in
	professional way.			



	diagnostic and therapeutic measures and can meet them appropriately.
	The students can apply their new knowledge and skills to a concrete therapy case.
	The students can introduce younger students to the clinical daily routine.
Autonomy	The students are able to access anatomical knowledge by themselves, can participate competently in
	conversations on the topic and acquire the relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
	Written exam
Examination duration	90 minutes
and scale	
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Biomechanics: Compulsory
A a a laura a sub-faurath a	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
Assignment for the Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective
	Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective
	Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



//	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring
Language	
Cycle	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units which determine a predefined sequence in their respective departments
Literature	<ul> <li>"Technik der medizinischen Radiologie" von T. + J. Laubenberg – 7. Auflage – Deutscher Ärzteverlag – erschienen 1999</li> <li>"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – 4. Auflage - Verlag Urban &amp; Fischer – erschienen 02.03.2006 ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg – erschiene 08.12.2009 ISBN: 978-3-437-47501-6</li> <li>"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012 ISBN: 978-3-13-567708-8</li> <li>"Der Körper des Menschen " von A. Faller u. M. Schünke - 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012 ISBN: 978-3-13-329716-5</li> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer –</li> </ul>



Courses				
Title		Тур	Hrs/wk	СР
Embodiment Design and 3D		Lecture	2	1
Mechanical Design Project I	. ,	Practical Course	3	2
Mechanical Design Project I	I (L0592)	Practical Course Project-/problem-based	3	2
Team Project Design Metho	dology (L0267)	Learning	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Eng</li> <li>Mechanics</li> <li>Fundamentals of Materials Scien</li> <li>Production Engineering</li> </ul>			
Educational Objectives	After taking part successfully, students ha	ave reached the following learnin	g results	
Professional				
Competence				
	After passing the module, students are a	ble to:		
Knowledge	<ul> <li>explain design guidelines for machinery parts e.g. considering load situation, materials an manufacturing requirements,</li> <li>describe basics of 3D CAD,</li> <li>explain basics methods of engineering designing.</li> </ul>			
	After passing the module, students are a • independently create sketches, to	echnical drawings and document	ations e.g. us	ing 3D CAD,
Skills	<ul> <li>design components based on design guidelines autonomously</li> </ul>			
Personal Competence				
	After passing the module, students are a	ble to:		
Social Competence	<ul> <li>develop and evaluate solutions in moderate the use of scientific me</li> <li>present and discuss solutions an</li> <li>reflect the own results in the work</li> </ul>	thods, d technical drawings within group	-	ecisions,
	Students are able			
Autonomy	<ul> <li>to estimate their level of knowledge</li> <li>clickers),</li> <li>To solve engineering design task</li> </ul>	edge using activating methods	within the lea	ctures (e.g. with
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science (Gern	nan program): Specialisation	Energy and	Enviromenta
	Engineering: Compulsory General Engineering Science (Ger Compulsory	man program): Specialisation	Mechanica	I Engineering
	General Engineering Science (German General Engineering Science (German		-	



	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Energy and Environmental
-	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory

Course L0268: Embodim	nent Design and 3D-CAD
Тур	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> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer- Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0695: Mechanic	cal Design Project I
Тур	Practical Course
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> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>

Course L0592: Mechani	ourse L0592: Mechanical Design Project II	
Тур	Practical Course	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Generation of sketches for functions and sub-functions</li> <li>Approximately calculation of shafts</li> <li>Dimension of bearings, screw connections and weld</li> <li>Generation of engineering drawings (assembly drawings, manufacturing drawing)</li> </ul>	
Literature	<ul> <li>Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.</li> <li>Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.</li> <li>Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.</li> <li>Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.</li> </ul>	



Тур	Project-/problem-based Learning
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
	Prof. Dieter Krause
Language	DE
Cycle	
Content	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Courses				
<b>Title</b> Numerical Mathematics I (Lt	0417)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>СР</b> 3
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Studer II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	nts (german or english) <b>or</b> Ai	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to</li> <li>name numerical methods for interpolation, integration, least squares problems, eigenvaluproblems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computation and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numeric</li> <li>justify the convergence behaviour of solution algorithm,</li> <li>select and execute a suitable solution a</li> </ul>	numerical methods with re		e problem ar
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously compand background knowledge), explain practical aspects regarding the implement</li> </ul>	theoretical foundations an		
Autonomy	<ul> <li>Students are capable</li> <li>to assess whether the supporting the individually or in a team,</li> <li>to assess their individual progess and, it</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program General Engineering Science (German prog Biomechanics: Compulsory General Engineering Science (German prog Materials in Engineering Sciences: Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Com	ram): Specialisation Mech ram): Specialisation Mech y m): Specialisation Biomedica ram, 7 semester): Specialisation m, 7 semester): Specialisation	anical Engi anical Engi al Engineeri isation Con	neering, Foc neering, Foc ng:Compulsc nputer Scienc



	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
Assignment for the	Electrical Engineering: Core qualification: Elective Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerica	al Mathematics I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell
Language	DE/EN
Cycle	WiSe
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>
Literature	<ul> <li>Stoer/Bulirsch: Numerische Mathematik 1, Springer</li> <li>Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer</li> </ul>



Course L0418: Numerica	rse L0418: Numerical Mathematics I	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne, Dr. Patricio Farrell	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Dr. Andreas Moschallski None Technical Thermodynamics I, II and Fluid I After taking part successfully, students hav The students are able to - describe the different physical mechanism - explain the technical terms,	re reached the following learning	Hrs/wk 3 2	<b>CP</b> 4 2
None Technical Thermodynamics I, II and Fluid I After taking part successfully, students hav The students are able to - describe the different physical mechanism	Lecture Recitation Section (large) Dynamics re reached the following learning	3 2	4
None Technical Thermodynamics I, II and Fluid I After taking part successfully, students hav The students are able to - describe the different physical mechanism	Recitation Section (large) Dynamics re reached the following learning		2
None Technical Thermodynamics I, II and Fluid I After taking part successfully, students hav The students are able to - describe the different physical mechanism	re reached the following learning	results	
Technical Thermodynamics I, II and Fluid I After taking part successfully, students hav The students are able to - describe the different physical mechanism	re reached the following learning	results	
After taking part successfully, students hav The students are able to - describe the different physical mechanism	re reached the following learning	results	
The students are able to - describe the different physical mechanisi		results	
The students are able to - describe the different physical mechanisi			
- describe the different physical mechanism	n of Heat Transfer		
	n of Heat Transfer.		
- explain the technical terms,	i er reat randier,		
- to analyse comlex heat transfer processe	s in a critical way.		
The students are able to			
- understand the physics of Heat Transfer,			
- calculate and evaluate complex Heat Tra	nsfer processes,		
- solve excersises self-consistent and in sr	nall groups.		
The students are able to discuss in small g	roups and develop an approach		
		nd analyse t	he results in
Independent Study Time 110, Study Time	in Lecture 70		
6			
Written exam			
120 min			
General Engineering Science (German	program): Specialisation Mech	anical Engi	neering, Foc
Biomechanics: Compulsory			
	program): Specialisation Mech	anical Engi	neering, Foc
	ogram): Specialisation Biomedica	al Engineerii	na: Compulso
General Engineering Science (German	program): Specialisation Mech	-	
	ogram, / semester): Specialisatic	on Mechanic	ai Engineerir
	ogram, 7 semester): Specialisatio	on Mechanic	al Engineerir
Focus Theoretical Mechanical Engineering	g: Compulsory		
	ogram, 7 semester): Specialisatio	on Biomedic	al Engineerir
	aram): Spacialization Biomodica	l Enginoorin	a: Compulso
		-	
Biomechanics: Compulsory			3, 190
	program): Specialisation Mecha	anical Engi	neering, Foc
	program): Specialization Mach	anical Engli	nooring Eco
		anicai Eligii	neening, FOC
		5	U,
	The students are able to - understand the physics of Heat Transfer, - calculate and evaluate complex Heat Tra- - solve excersises self-consistent and in sr The students are able to discuss in small gr The students are able to develop a con- critical way. A qualified exchange with other Independent Study Time 110, Study Time 6 Written exam 120 min General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German Energy Systems: Compulsory General Engineering Science (German Theoretical Mechanical Engineering: Com- General Engineering Science (German pro- General Engineering Science (German pro- Focus Energy Systems: Compulsory General Engineering Science (German pro- Focus Theoretical Mechanical Engineering General Engineering Science (German pro- Focus Theoretical Mechanical Engineering General Engineering Science (German pro- General Engineering Science (German pro- General Engineering Science (English pro- Biomechanics: Compulsory General Engineering S	<ul> <li>- understand the physics of Heat Transfer,</li> <li>- calculate and evaluate complex Heat Transfer processes,</li> <li>- solve excersises self-consistent and in small groups.</li> </ul> The students are able to discuss in small groups and develop an approach the students are able to develop a complex problem self-consistent ar critical way. A qualified exchange with other students is given. Independent Study Time 110, Study Time in Lecture 70 6 Written exam 120 min General Engineering Science (German program): Specialisation Mech Biomechanics: Compulsory General Engineering Science (German program): Specialisation Mech Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mech Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mech Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mech Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedica General Engineering Science (English program): Specialisation Mechanica: Compulsory General Engineering Science (English program): Specialisation M	The students are able to - understand the physics of Heat Transfer, - calculate and evaluate complex Heat Transfer processes, - solve excersises self-consistent and in small groups. The students are able to discuss in small groups and develop an approach. The students are able to develop a complex problem self-consistent and analyse t critical way. A qualified exchange with other students is given. Independent Study Time 110, Study Time in Lecture 70 6 Written exam 120 min General Engineering Science (German program): Specialisation Mechanical Engi Biomechanics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engi Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engi Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanica Engineering General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Biomedical Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering Biom



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Course L0458: Heat Tra	nsfer
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996</li> </ul>

Course L0459: Heat Tra	Course L0459: Heat Transfer	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Andreas Moschallski	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Measurement Technology for	nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118)	<b>Typ</b> Practical Course Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible				
Admission				
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ctrical engineering		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).			
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-		
	They can describe important methods of o Chromatography)	chemical Analysis (Gas Se	nsors, Spe	ctroscopy, G
Skills	Students can select suitable measuring measurement devices in practice. The students are able to orally explain issue solution approaches as well as place the issue	s in the subject area of me	asurement	technology a
Personal Competence	Students can arrive at work results in groups a	nd document them in a comn	non report.	
Social Competence				
	Students are able to familiarize themselves wit		ogies.	
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points Examination				
Examination duration and scale	105 minutes			
	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Enviromental Engineering: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra	program): Specialisation m): Specialisation Biomedica m): Specialisation Process E program, 7 semester): Sp m, 7 semester): Specialisatio um, 7 semester): Specialisatio	Mechanica al Engineeri ngineering: becialisatior on Mechanic on Biomedic	I Engineerir ng: Compulsor Compulsory Energy a al Engineerir al Engineerir
	Compulsory Energy and Environmental Engineering: Core			



Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Process Engineering: Core qualification: Compulsory



Course L1119: Practical	Course: Measurement and Control Systems
	Practical Course
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
	WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 BI.1, 2451 BI.4, 2453 BI.5, 2455 BI.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



Тур	Lecture
Hrs/wk	2
CP	3
	Independent Study Time 62, Study Time in Lecture 28
	Dr. Sven Krause
Language	
Cycle	VISe 1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Content	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in from the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940.



Course L1118: Measure	rse L1118: Measurement Technology for Mechanical and Process Engineers	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry	and Molecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students h	ave reached the following le	earning results	
Professional Competence	The students can			
Knowledge	<ul> <li>describe basic biomolecules;</li> <li>explain how genetic information</li> <li>explain the connection between</li> </ul>			
Skills	The students can <ul> <li>recognize the importance of mol</li> <li>describe selected molecular-dia</li> <li>explain the relevance of these p</li> </ul>	gnostic procedures;		
Personal Competence				
Social Competence	The students can participate in discussi	ons in research and medicin	ie on a technical le	vel.
Autonomy	The students can develop understand themselves.	ling of topics from the cou	irse, using technic	al literature, b
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points	3			
Examination				
Examination duration and scale				
Assignment for the Following Curricula	Ecous Biomachanica: Compulsory		ng: Compulso cal Engineering cal Engineering ineering, Focu ng: Compulsor cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering	

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Course L0386: Introduct	urse L0386: Introduction to Biochemistry and Molecular Biology	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Hans-Jürgen Kreienkamp	
Language	DE	
Cycle	WiSe	
Content		
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage	
	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008	
Literature		

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-				_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic particular explain properties of firs</li> <li>They can explain the dynamics terms of frequency response and</li> <li>They can explain the Nyquist stab</li> <li>They can explain the role of the pl</li> <li>They can explain the way a PIE response</li> <li>They can explain issues arising implemented digitally</li> </ul>	st and second order systems of simple control loops and inter root locus ility criterion and the stability marg hase margin in analysis and synth D controller affects a control loop	rpret dynam gins derived esis of contr o in terms o	ic properties from it. rol loops of its frequenc
Skills	<ul> <li>Students can transform models o vice versa</li> <li>They can simulate and assess the They can design PID controllers w</li> <li>They can analyze and synthes frequency response techniques</li> <li>They can calculate discrete-time and use it for digital implementatio</li> <li>They can use standard software to tasks</li> </ul>	behavior of systems and control l vith the help of heuristic (Ziegler-N ize simple control loops with th approximations of controllers do on	oops ichols) tunir ne help of esigned in d	ig rules root locus ar continuous-tim
Personal Competence				
Social Competence	Students can work in small groups to jo their controller designs	pintly solve technical problems, a	and experim	entally valida
Autonomy	Students can obtain information from experiment guides) and use it when solvi They can assess their knowledge in weel	ng given problems.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	isation Con	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	( `ompuleony
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



	Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
-	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
(	Compulsory
F	Process Engineering: Core qualification: Compulsory

	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Signals and systems    Linear systems, differential equations and transfer functions  First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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  Root locus techniques Root locus techniques Bode diagram Minimum and non-minimum phase systems Styquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Similar predictor  Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1333: Blo	O I: Implants and Fracture He	ealing		
Courses				
Title Implants and Fracture Healing	ng (L0376)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in Fracture Healing".	"Introduction into Anatomie"	before attending	"Implants and
Educational Objectives	After taking part successfully, students	have reached the following lea	rning results	
Professional Competence				
	The students can describe the difference.	erent ways how bones heal,	and the require	ments for their
Knowledge	The students can name different trea morphologies.	atments for the spine and hol	low bones under	given fracture
Skills	The students can determine the force under specific assumptions.	es acting within the human bo	ody under quasi-	static situations
Personal Competence				
Social Competence	The students can, in groups, solve bas	ic numerical modeling tasks for	the calculation of	internal forces
Autonomy	The students can, in groups, solve bas	ic numerical modeling tasks for	the calculation of	internal forces
Workload in Hours	Independent Study Time 62, Study Tim	ne in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
	<ul> <li>General Engineering Science (German program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory</li> <li>General Engineering Science (German program): Specialisation Biomedical Engineering: Compuls</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering</li> <li>Focus Biomechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering</li> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering</li> <li>Compulsory</li> <li>General Engineering Science (English program): Specialisation Biomedical Engineering; Compuls</li> <li>General Engineering Science (English program): Specialisation Mechanical Engineering, For</li> <li>Biomechanics: Compulsory</li> <li>or the General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering</li> <li>ricula</li> <li>Focus Biomechanics: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering</li> <li>ricula</li> <li>Focus Biomechanics: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering</li> <li>Compulsory</li> <li>Mechanical Engineering: Specialisation Biomechanics: Compulsory</li> <li>Biomedical Engineering: Specialisation Biomechanics: Compulsory</li> <li>Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory</li> <li>Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compuls</li> <li>Biomedical Engineering: Specialisation Management and Business Administration: Electory</li> <li>Compulsory</li> <li>Technomathematics: Specialisation III. Engineering Science: Elective Compulsory</li> </ul>		ng: Compulsor al Engineering g: Compulsory neering, Focus al Engineering al Engineering licine: Elective lsory ve Compulsory	



ourse L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28 Prof. Michael Morlock
Lecturer	
Cycle	
	Topics to be covered include:
	1. Introduction (history, definitions, background importance)
	2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
	3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine
	3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
Content	5 Fracture Healing
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates
	5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
	Cochran V.B.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
Literature	
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat
	l



Module M0829: Fo	undations of Management			
Courses				
Title	(1.0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (Li		Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most import aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourci supply chain management, organization and human ressource management, informati management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations und multiple objectives and uncertainty, and explain some basic methods from mathemati Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>		e most importa t and sourcin ent, informatic situations unde	
Skills	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 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 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		y are able to y and under risi is	
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the lareport on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their formation in the statement of the statement of</li></ul>	ecture to an entrepreneurship p	project and v	write a cohere
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the t</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



and scale	l
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor
	General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	
Following Curricula	
i olioting our louid	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Energy and Enviromenta Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture. Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture

	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
<u> </u>	Process Engineering: Core qualification: Compulsory



Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 48, Study Time in Lecture 42
	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kath
Lecturer	Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and stratege information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



Module M0634: Introduction into Medical Technology and Systems				
Courses				
Introduction into Medical Teo	chnology and Systems (L0342) chnology and Systems (L0343) chnology and Systems (L1876)	<b>Typ</b> Lecture Project Seminar Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 3 2 1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements				
Recommended Previous Knowledge	principles of math (algebra, analysis/calculus) principles of stochastics principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
	The students can explain principles of medical technology, including imaging systems, computer aided surgery, and medical information systems. They are able to give an overview of regulatory affairs and standards in medical technology.			
Skills	The students are able to evaluate systems and medical devices in the context of clinical applications.			
Personal Competence				
Social Competence	The students describe a problem in medical technology as a project, and define tasks that are solved in a joint effort.			
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			



Course L0342: Introduct	ion into Medical Technology and Systems
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>
Literature	Wird in der Veranstaltung bekannt gegeben.

Тур	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1876: Introduction into Medical Technology and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>	
Literature	Wird in der Veranstaltung bekannt gegeben.	



Module M1280: ME	ED II: Introduction to Physiology		
•			
Title Introduction to Physiology (L	L0385) Typ Hrs/wk Locture 2	<b>СР</b> 3	
Module Responsible	Dr. Roger Zimmermann		
Admission Requirements			
Recommended Previous Knowledge			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	<ul> <li>describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology.</li> </ul>		
Skills	of information, development of forces and vital functions) and relate them to similar technical systems.		
Personal Competence			
Social Competence	The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrological		
Autonomy	The students can derive answers to questions arising in the course and other ph using technical literature, by themselves.	ysiological areas	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Credit points			
	Written exam		
Examination duration and scale	60 minutes		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		



ourse L0385: Introduction to Physiology		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Roger Zimmermann	
Language	DE	
Cycle	SoSe	
Content		
	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme	
Literature	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier	



Module M1332: BIC	DI: Experimental Methods	in Biomechanics		
Courses				
<b>Title</b> Experimental Methods in Bio	mechanics (L0377)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
	It is recommended to participate in Methoden".	"Implantate und Frakturheilung" b	efore attending '	'Experimentell
Educational Objectives	After taking part successfully, studer	its have reached the following lear	ning results	
Professional Competence				
Knowledge	The students can describe the d existence. The students can name different t morphologies. The students can describe different the adequate technique for a given t	reatments for the spine and hold	ow bones under	given fractur
Skills	The students can describe the biomechanics.	basic handling of several exp	erimental techni	iques used i
Personal Competence				
- 1	The students can, in groups, solve b	asic experimental tasks.		
Autonomy	The students can, in groups, solve b	asic experimental tasks.		
Workload in Hours	Independent Study Time 62, Study 1	ime in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (Ge Biomechanics: Compulsory General Engineering Science (Gern General Engineering Science (Gern Focus Biomechanics: Compulsory General Engineering Science (Gern Compulsory General Engineering Science (Engli General Engineering Science (Engli General Engineering Science (Engli Focus Biomechanics: Compulsory General Engineering Science (Engli Focus Biomechanics: Compulsory General Engineering Science (Engli Compulsory Mechanical Engineering: Specialisa Biomedical Engineering: Specialisa	nan program): Specialisation Biom nan program, 7 semester): Special nan program, 7 semester): Special ish program): Specialisation Biome glish program): Specialisation M ish program, 7 semester): Special ish program, 7 semester): Special tion Biomechanics: Compulsory sation Artificial Organs and Re tion Implants and Endoprostheses tion Medical Technology and Cont	edical Engineerin isation Mechanic isation Biomedic edical Engineerin Mechanical Engin isation Mechanic isation Biomedic egenerative Mec : Elective Compu rol Theory: Electi	ng: Compulsor al Engineering g: Compulsor neering, Focu al Engineering al Engineering licine: Electiv lsory ve Compulsor



ourse L0377: Experimental Methods in Biomechanics		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Michael Morlock	
Language	DE	
Cycle	SoSe	
Content		
Literature	Wird in der Veranstaltung bekannt gegeben	



## **Specialization Naval Architecture**

The Bachelor Course "Naval Architecture" prepares by the elective modules for scientific tasks in naval architecture, ocean engineering and related mechanical engineering disciplines. Thus, the occupational orientation can either related to the design of ships or offshore systems, or to more dedicated areas, such as hydrodynamics or strength of structures.

Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Herbert Werner			
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				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can is particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties it terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain ar implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to joint their controller designs	ly solve technical problems, a	nd experim	entally valida
Autonomy	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.			



Worklead in Hours         Independent Study Time 124, Study Time in Lecture 56         Examination         Written exam         Isometical formation         and scale         120 min         General Engineering Science (German program): Core qualification: Compulsory         General Engineering Science (German program): Core qualification: Compulsory         General Engineering Science (German program, 7 semester): Specialisation Computer Science         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         Compulsory         Compulsory         Compulsory
and scale       120 min         General Engineering Science (German program): Core qualification: Compulsory         General Engineering Science (German program, 7 semester): Specialisation Computer Science         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory
and scale         General Engineering Science (German program): Core qualification: Compulsory         General Engineering Science (German program, 7 semester): Specialisation Computer Science         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory         General Engineering Science (German program, 7 semester): Specialisation Naval Architect         Compulsory
General Engineering Science (German program, 7 semester): Specialisation Computer Scien Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architect Compulsory
General Engineering Science (German program, 7 semester): Specialisation Civil Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy Enviromental Engineering Science (German program, 7 semester): Specialisation Process Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Aitrati Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Energy Systems: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (Eeglish program, 7 semester): Specialisation Mechanical Engineer Focus Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Comp
Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineer Compulsory
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineer
Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Envirome
Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineer Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer
Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer



Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
Compulsory
Process Engineering: Core qualification: Compulsory





Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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Courses		True	Line hude	<u></u>
<b>Title</b> Computer Engineering (L032	21)	Typ Lecture	Hrs/wk 3	<b>CP</b> 4
Computer Engineering (L032		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission	None			
Requirements	None			
	Basic knowledge in electrical engineering			
	The successful completion of the labs will be examination according to the following rules:	honored during the e	valuation of	the module
Previous Knowledge	<ol> <li>Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>The improvement of the grade 5,0 up to 4,3</li> </ol>	at the examination's ma	rks are lifted	
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional				
Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124 Study Time in Least	ro 56		
Credit points	Independent Study Time 124, Study Time in Lectur			
-				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Core qualification: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Sciences (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory
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Course L0321: Compute	er Engineering		
Тур	Lecture		
Hrs/wk			
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer Engineering		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0829: Fo	undations of Management			
Courses				
Title	(L0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (Lu	0882)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students hav	e reached the following learning	g results	
Professional Competence	After taking this module, students know th			
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>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 <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coherer report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	Students are able to			
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points		·		
-	Subject theoretical and practical work			
Examination duration	<u> </u>			



and scale	
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor
	General Engineering Science (German program): Specialisation Energy and Environmenta
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromenta
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering
	Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor
	General Engineering Science (German program): Specialisation Biomedical Engineering. Compulsor General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy an
	Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	deneral Engineering odenee (English program): opecialisation of an environmental Engeneering
	comparenty
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering. Compulsory General Engineering Science (English program): Specialisation Energy and Enviroment: Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Octoputer Science: Computery
	General Engineering Science (English program): Specialisation Nechanical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor
	General Engineering Science (English program): Specialisation Diomedical Engineering: Compusor General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program): Specialisation Naval Alchitecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architectur

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory



Typ	Lecture	
Hrs/wk		
CP		
	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateg information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>	



Course L0882: Project Entrepreneurship		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	

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Courses				
Title	tial Differential Equations) (L1043)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b>
	tial Differential Equations) (L1043)	Recitation Section (small)	2	1
	tial Differential Equations) (L1044)	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. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following learning	g results	
Professional				
Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in thi course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are abl to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperatir partners. Moreover, they can design examples to check and deepen the understanding of the peers.</li> </ul>			
Autonomy	<ul> <li>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.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time	in Lecture 112		
Credit points	6			
Examination	Written exam			

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus



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	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	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 Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	Mechatronics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Mechanical Engineering: Specialisation Mechatronics: 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)		
Тур	Lecture	
Hrs/wk	2	
СР	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	<ul> <li>Main features of the theory and numerical treatment of partial differential equations</li> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	



Course L1044: Differential Equations 2 (Partial Differential Equations)		
Тур	Typ Recitation Section (small)	
Hrs/wk	1	
СР	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)	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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
Тур	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	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>



Course L1041: Complex	ourse L1041: Complex Functions		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	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		

se L1042: Complex Functions	
Тур	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

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Module M0960: N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Mechan	ics, Multibody	
oyotemo,			
Courses			
Title	Typ Hrs/w	vk CP	
(L1137)	Oscillations, Analytical Mechanics, Multibody Systems) Lecture 3	3	
(LII30)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small) 2	2	
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) 1	1	
Module Responsible			
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III		
	After taking part successfully, students have reached the following learning results		
Professional			
Competence			
	The students can		
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>		
	The students can		
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation and apply it to the context of their own problems;</li> <li>apply basic methods to engineering problems;</li> <li>estimate the reach and boundaries of the methods and extend them to be applicable to wide problem sets.</li> </ul>		
Personal Competence			
Social Competence	The students conjugation strains and support cook other to support difficulties.		
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their tim and learning based on those.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Examination	Written exam		
Examination duration and scale	120 min		
	General Engineering Science (German program): Specialisation Mecha	inical Engineering	
	Compulsory General Engineering Science (German program): Specialisation Biomedical Engir	ooring Computer	
	General Engineering Science (German program): Specialisation Biomedical Engin General Engineering Science (German program): Specialisation Naval Architectur General Engineering Science (German program, 7 semester): Specialisation Mech Compulsory	e: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biorr Compulsory	nedical Engineering	
	General Engineering Science (German program, 7 semester): Specialisation Compulsory	Naval Architectur	
Assignment for the Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engin General Engineering Science (English program): Specialisation Biomedical Engin General Engineering Science (English program): Specialisation Naval Architecture	eering: Compulsor e: Compulsory	



Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Core qualification: Elective Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
 Compulsory

Тур	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	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
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) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

urse L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Recitation Section (small)		
2		
2		
Independent Study Time 32, Study Time in Lecture 28		
Prof. Robert Seifried		
DE		
SoSe		
See interlocking course		
See interlocking course		



ourse L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title	Тур		Hrs/wk	СР
Fluid Mechanics (L0454)LectureFluid Mechanics (L0455)Recitation Section (large			3 2	4 2
Module Responsible	Prof. Thomas Rung			
Admission Requirements				
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics and thermodynamics.			
Educational Objectives	After taking part successfully, students have reached the	e following learning r	results	
Professional Competence	<b>•</b>			.,
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineerin and physics of fluids. Students can scientifically outline the rationale of flow physics usin mathematical models and are familiar with methods for the performance analysis and the prediciton fluid engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop solution strategies.			
Autonomy	The students are able to develop solution strategies for analyse results.	r complex problems s	self-consiste	ent and crtica
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	1		
Credit points	6			
Examination	Written exam	_		
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory 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 Naval Architecture Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			



## Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0454: Fluid Mechanics			
Тур	Lecture		
Hrs/wk	3		
СР			
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Thomas Rung		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Overview</li> <li>Physical/mathematical modelling</li> <li>Special phenomena</li> <li>Basic equations of fluid dynamics</li> <li>The turbulence problem</li> <li>One dimensional theory for inkompressibel flows</li> <li>One dimensional theory for kompressibel flows</li> <li>Flow over contours without friction</li> <li>Flow over contours with friction</li> <li>Flow through channels</li> <li>Simplified equations for three dimensional flow</li> <li>Special aspects of the numerical solution for complex flows</li> </ul>		
Literature	<ul> <li>Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006</li> <li>Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004</li> </ul>		

Course L0455: Fluid Mechanics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0640: Sto	ochastics and Ship Dynamics			
Courses				
Title	Тур		Hrs/wk	СР
Ship Dynamics (L0352)		9	2	3
Ship Dynamics (L1620)	Recitat	ion Section (small)	1	1
Statistics and Stochastic P	rocesses in Naval Architecure and Ocean Engineering	e	2	3
(L0364)	Prof. Moustafa Abdel-Maksoud			
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Technical mechanics</li> <li>Linear algebra, analysis, complex numbers</li> <li>Fluid mechanics</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the	following learning r	results	
Professional Competence				
Competence	- The students are able to give an overview over vario		hoy can na	mo applicatio
	goals and they can describe the procedure of the manoer		ney can na	
	- The students are able to give an overview over varius	rudder types. The	ev can nam	e criteria in th
	rudder design.		y our num	
Knowledge	- The students can name computation methods which a	are used to determ	ine forces	and motions
	waves.			
	- The students can come up with the equations of motions can use and linearise them.	s which are used to	discribe ma	anoeuvres. Th
	- The students are able to determine hydrodynamic coe meaning.	efficients and they	can explaiı	n their physic
Skills	- The students can explain how a rudder works and the occur.	y can explain the	physical eff	ects which ca
	- The students can mathematically describe waves.			
	- The students can explain the mathematically description can determine them.	on of harmoncial n	notions in v	vaves and the
Personal Competence				
	- The students can arrive at work results in groups and do	ocument them.		
Social Competence	- The students can discuss in groups and explain their po			
Autonomy	- The students can assess their own strengthes and weaknesses and the define further work steps or this basis.			
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program): Specia General Engineering Science (German program, 7 se Compulsory General Engineering Science (English program): Special	emester): Specialis	sation Nava	al Architectur



 Following Curricula
 General
 Engineering
 Science
 (English
 program, 7
 semester):
 Specialisation
 Naval
 Architecture:

 Compulsory
 Naval
 Architecture:
 Compulsory
 Naval
 Architecture:
 Compulsory
 Naval
 Architecture:
 Compulsory
 Naval
 Architecture:
 Compulsory
 Naval
 Architecture:
 Compulsory
 Naval
 Naval

Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

urse L0352: Ship Dyn	
	Lecture
Hrs/wk	
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships • Equations of motion • Hydrodynamic forces and moments • Linear equations and their solutions • Full-scale trials for evaluating the maneuvering performance • Regulations for maneuverability • Rudder Seakeeping • Representation of harmonic processes • Motions of a rigid ship in regular waves • Flow forces on ship cross sections • Strip method • Consequences induced by ship motion in regular waves • Behavior of ships in a stationary sea state • Long-term distribution of seaway influences
Literature	<ul> <li>Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik u Schiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and St Theory, Hamburg University of Technology, 2014</li> <li>Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House Jordan Hill, Oxford, United Kingdom, 2000</li> <li>Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley &amp; Sons, Canada,1978</li> <li>Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993</li> <li>Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Ber Heidelberg, Deutschland, 1992</li> <li>Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Pres United Kingdom, 1990</li> <li>Handbuch der Werften, Deutschland, 1986</li> <li>Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdo 2001</li> <li>Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllabili Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989</li> <li>Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, Wo Scientific, USA, 2004</li> <li>Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdo 1998</li> </ul>



Course L1620: Ship Dynamics		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Moustafa Abdel-Maksoud	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	<ul> <li>descriptive statistics, parameter, criteria for outliers</li> <li>sample, sample space, probability, probability space</li> <li>Bayes method, conditional probability, law of total probability</li> <li>Discrete and continuous random variables</li> <li>Probability distributions</li> <li>mixed and joint random variables and their distribution</li> <li>Characteristics of random variables (expectation, variance, skewness, kurtosis,)</li> <li>(central) limit theorem</li> <li>Stochastic processes</li> <li>Statistical description of seaway, harmonic analysis of seaway</li> <li>narrow-banded Gaussian process, seaway and its characteristics</li> <li>sea- and wind spectra</li> <li>transformation of spectra, transfer function</li> </ul>
Literature	<ul> <li>V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsberei Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001</li> <li>H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3<sup>rd</sup> Editid John Wiley &amp; Sons, Inc., New York, NY, 2009</li> <li>ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towi Tank Conference (ITTC), 2011</li> <li>F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability a Statistics, Springer, 2005</li> <li>Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006</li> <li>A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013</li> </ul>

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Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynami	cs I (L0235)	Lecture	2	3
Computational Fluid Dynami	cs I (L0419)	Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge			S	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial differential equations.			
Skills	The students are able develop appropriate partial differential equations. They can code			-
Personal Competence Social Competence	The students can arrive at work results in gro	oups and document them.		
Autonomy	The students can independently analyse ap	proaches to solving specific pro	oblems.	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
	Written exam			
Examination duration and scale	2h			
-	General Engineering Science (German program): Specialisation Mechanical Engineering, Fo Energy Systems: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architect Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Energy Systems: Elective Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Fo Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Fo Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architect Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architect Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



Course L0235: Computa	tional Fluid Dynamics I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	<ul> <li>Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.</li> <li>1. Partial differential equations</li> <li>2. Foundations of finite numerical approximations</li> <li>3. Computation of potential flows</li> <li>4. Introduction of finite-differences</li> <li>5. Approximation of convective, diffusive and transient transport processes</li> <li>6. Formulation of boundary conditions and initial conditions</li> <li>7. Assembly and solution of algebraic equation systems</li> <li>8. Facets of weighted -residual approaches</li> <li>9. Finite volume methods</li> <li>10. Basics of grid generation</li> </ul>
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer

	Itional Fluid Dynamics I
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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Courses				
<b>Title</b> Fundamentals of Ship Struct Fundamentals of Ship Struct Fundamentals of Ship Struct	tural Design (L0413)	<b>Typ</b> Lecture Recitation Section (small) Lecture	<b>Hrs/wk</b> 2 1 2	<b>CP</b> 2 2 2
Fundamentals of Ship Struct		Recitation Section (small)	2 1	2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional				
Competence	Students can reproduce the basic contents of the structural behaviour of ship structures; they can explain the theory and methods for the calculation of deformations and stresses in beam-line structures.			
Kilowieuge	Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished product joining and principles of structural design of components in the ship structure. Students are capable of applying the methods and tools for the calculation of linear deformations a stresses in the above mentioned structures; they can choose calculation models of typical si structures.			
Skills	Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they c select suitable materials, semi-finished products and joints.		ucture; they ca	
Personal Competence				
Social Competence	The students are able to communicate an shipbuilding and component supply industry.	d cooperate in a profess	sional envir	onment in th
	The students are capable to independently idealize real ship structures and to select suitable method for analysis of beam-like structures; they are capable to assess the results of structural analyses.			
Autonomy	Furthermore, they are capable to assess dra structures for various requirements and bounda		ictures and	to design sh
Workload in Hours	Independent Study Time 156, Study Time in Le	cture 84		
Credit points				
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory			

Naval Architecture: Core qualification: Compulsory

Course L0411: Fundame	Course L0411: Fundamentals of Ship Structural Design		
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Sören Ehlers		
Language	DE		
Cycle	WiSe		
Content	Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON)		
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht		

Course L0413: Fundamentals of Ship Structural Design		
Тур	Recitation Section (small)	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON)	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	



Course L0410: Fundame	entals of Ship Structural Analysis
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Contents: 1. Introduction 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

ourse L0414: Fundame	entals of Ship Structural Analysis
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Contents: 1. Introduction 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

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Module M0664: Str	ructural Design and Construction of	Ships		
Courses				
<b>Title</b> Ship Structural Design (L04 <sup>-</sup> Ship Structural Design (L04 <sup>-</sup> Welding Technology (L1123	15)	<b>Typ</b> Lecture Recitation Section (small) Lecture	<b>Hrs/wk</b> 2 2 3	CP 3 3 3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have react	ned the following learning	results	
Professional Competence		well as fabrication of t	ha different	areas of ship
Knowledge	Students can reproduce design and sizing as structures and of different ship types (incl. deta complex structures.			
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for the components, to select suitable calculation models and to assess the chosen structure			
Personal Competence Social Competence	Students are capable to present their structural of	lesign and discuss their d	ecisions co	nstructively in a
Autonomy	Students are capable to design independently or ship types and to define appropriate fabrication m		f the ship hi	ull and different
Workload in Hours	Independent Study Time 172, Study Time in Lectu	ure 98		
Credit points				
-	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula				



Course L0412: Ship Stru	ctural Design
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

urse L0415: Ship Stru	ictural Design
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht



Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	DE
Cycle	WiSe
	- phase transitions, phase diagrams and thermal activated processes
	- fundamentals of steels, heat treatment applications for steels and time temperature transformat diagrams
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength stee
	- structure and properties of non-ferrite metals (aluminum, titanium)
	- NDT/DT Methods for materials and welds
	- gas fusion welding, fundamentals of electric arc welding technologies
	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas me arc welding (MAG)/Plasma Welding
	- resistance welding/ polymer welding/ hybrid-welding
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnise Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit Schweißkonstruktionen, 2. Aufl., Berlin 2002.



Module M1109: Re	sistance and Propulsion			
Courses				
Title Resistance and Propulsion ( Resistance and Propulsion (		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible		( 0 )		
Admission Requirements				
Recommended Previous Knowledge	Eluid Dynamics for Naval Architects			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for re- different resistance phenomena and their pra- numerical and empirical prediction methods are additional resistances are dealt with. The course to full scale ships. This hold also for propulsion and wake. Main Focus is how hull forms can consumption. The following topics are dealt with:	ctical applications to hu subject of the course. I includes model test techn and hullefficiency elemen	Illform desi Furthermore hiques and t hts, mainly t	gn as well as , environmenta heir applicatior hrust deductior
	- Stillwater/added resistance, Wave resistance, M methods, friction laws, laminar/turbulent flow sepa Appendage Design and resistance, Froude's re wake, model scaling laws, resistance tests, fr propulsion tests, full scale speed power predicti sea state), EEDI, speed trials, contractual matters	aration, Hull form design f esistance law,form factor ree running propeller te ons, additional resistanc	or redcude f method, th ests and pr es (wind, st	flow separation rust deduction opeller basics eering, curren
Skills	The student shall learn to design competitve hull numreical techniques and to evaluate these hu course will enable the student to clearl deter environmental influences.	Ills by several progosis	methods.	Furtermore, the
Personal Competence				
Social Competence	The student learns to prepare technical matters suvervision team.	in such a way that he ca	in compte w	vith his building
Autonomy	The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): General Engineering Science (German program Compulsory General Engineering Science (English program): General Engineering Science (English program Compulsory Naval Architecture: Core qualification: Compulsor	n, 7 semester): Special Specialisation Naval Arch n, 7 semester): Speciali	isation Nav hitecture: Co	al Architecture



Course L1265: Resistan	ourse L1265: Resistance and Propulsion	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L1266: Resistan	urse L1266: Resistance and Propulsion	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1118: Hy	drostatics and Body Plan			
Courses				
<b>Title</b> Hydrostatics (L1260) Hydrostatics (L1261)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 1
Body Plan (L1452)		Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in Mathemathics I-III and Mechanics I-III. It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan, GA- Plan, Tank Plan etc.			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	acientific level. The lecture is basic requirement for all following lectures in the subjects abing design			
Skills	The student is able to carry out hydrostatic calculations to ensure that the ship has sufficient stability He is able to design hull forms that are safe against capsizing or sinking.			
Personal Competence				
Social Competence				
Autonomy Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
•	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula				

Course L1260: Hydrostatics		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
	1. Numerical Integration, Diffrentation, Interpolation	
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods	
	- Determination of Areas, 1st and 2nd order Moments	
	- Numerical Diffrentation, Spline Interpolation	

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- Principle of Archimedes
- Equlibrium Floating Condition
- Equlibrium Computations
- Hydrostatic Tables and Sounding Tables
- Trim Tables
- 3. Stability at large heeling angles
- Stability Equation
- Cross Curves of Stability and Righting Levers
- Numerical and Graphical Determination of Cross Curves
- Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
- Heeling Moments of Different Type
- Balance of Heeling and Righting Moments acc. to BV 1030
- Intact Stability Code (General Critaria)
- 4. Linearization of Stability Problems
  - Linearization of Restoring Forces and Moments
  - Correlation between Metacentric Height and Righting Lever at small heeling angles
  - Computation of Path of Metacentric Height for Modern Hull Forms
  - Correlation between Righting Lever and Path of Metacentric Height
  - Hydrostatic Stiffness Matrix
  - Definition of MCT
  - Computation of Equilibrum Floating Conditions from Hydrostatic Tables
  - Effect of Free Surfaces on Initial GM
  - Roll Motions at Small Roll Angles
- 6. Stability in Waves
- Roll Motions at Large Amplitudes
- Pure Loss of Stability on the Wave Crest
- Principle of Parametric Excitation
- Principle of Direct Wave Moments
- Content
- Grim's Equivalent Wave Concept
- 6 Longitudinal Strength
  - Longitudinal Mass Distribution, Shear Forces, Bending Moments
- Longitudinal Strength in Stability Booklet
- 7. Deadweight Survey and Inclining Experiment
  - Deplacement Computations from Draft mark Readings
- Weights to go on /come from board
- Inclining Experiment with Heeling Moments from Weights and Heeling Tanks
- Residual Sounding Volumes



	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.
Literature	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig     2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin
	- e.g. Sinking After Water Ingress
	- e.g. Jacking of Jackup Vessels
	- e.g. Heavy Lift Operations
	11. Special Problems (optional and agreed upon)
	- Water Ingress Through Openings
	- Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
	- Simple Equilibrium Computations
	- Loss of Buoyant Volume Method
	- Added Mass Method
	10. Introduction into Damage Stability Problems
	- Ship Grounds on Keel
	- Pointwise Grounding
	- Loss of Buoynacy when Grounded
	9. Grounding
	- Transversal Stability on Slipway and in Dock
	- Linear- Elastic Effects
	- Bottom Pressure and Longitudinal Strength
	- Computation of Launching Event
	- Launching Plan, Arrangement of Launching Blocks - Rigid Body Launching: Tilting, Dumping, Equation of Techel
	8. Launching and Docking
	- Roll Decay Test



Course L1261: Hydrosta	ourse L1261: Hydrostatics	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1452: Body Plan		
Тур	Project Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	WiSe	
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.	
Literature	<ol> <li>Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig</li> <li>Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin</li> <li>Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.</li> </ol>	



Module M0933: Fu	ndamentals of Materials Science			
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Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S		Lecture	2	2
Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and car 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.			
Skills	The students are able to trace materials phenom laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosic solidification, precipitation, or melting. The stud conditions and the materials microstructure, and t the material's behavior.	to mechanical properties on resistance, and to pha ents can explain the rel	such as stress se transform ation betwee	ength, ductilit ations such a en processin
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
-	Vritten exam			
Examination duration and scale	 180 min			
	General Engineering Science (German prog	ram): Specialisation E	nergy and	Enviroment
	Engineering: Compulsory			
	General Engineering Science (German pro	gram): Specialisation	Mechanical	Engineerin
	Compulsory General Engineering Science (German program):	Specialisation Biomedica	l Engineerin	a: Compulso
	General Engineering Science (German program):			
	General Engineering Science (German program, 7	-		
	Compulsory			
	General Engineering Science (German program, 7 Compulsory	v semester): Specialisatio	n Biomedica	ai Engineering
	General Engineering Science (German progran Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		ecialisation	Energy an



Assignment for the	Engineering (Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mava Actinecture. Compusory
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L1085: Fundamentals of Materials Science I		
Тур	Lecture	
Hrs/wk	2	
СР	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	

Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	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	



Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Stefan Müller		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Motivation: "Atoms in Mechanical Engineering?"</li> <li>Basics: Force and Energy</li> <li>The electromagnetic Interaction <ul> <li>"Detour": Mathematics (complex e-funktion etc.)</li> </ul> </li> <li>The atom: Bohr's model of the atom</li> <li>Chemical bounds</li> <li>The multi part problem: Solutions and strategies</li> <li>Descriptions of using statistical thermodynamics</li> <li>Elastic theory of atoms</li> <li>Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)</li> </ul>		
Literature	<ul> <li>Für den Elektromagnetismus:</li> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> <li>Für die Atomphysik: <ul> <li>Haken, Wolf: "Atom- und Quantenphysik", Springer</li> </ul> </li> <li>Für die Materialphysik und Elastizität: <ul> <li>Hornbogen, Warlimont: "Metallkunde", Springer</li> </ul> </li> </ul>		



Module M1110: Sh				
Courses				
<b>Title</b> Ship Design (L1262) Ship Design (L1264)	L	<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>СР</b> 3 3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fluid Dynamics for Naval Architects, Resista</li> <li>Resistance and Propulsion, Hydrostatics</li> </ul>	nce and Propulsion		
Educational Objectives	After taking part successfully, students have reached	d the following learning	results	
Professional Competence	The lecture starts with an overview about the impor Competitive Elements of Ship Designs are thoroug			
	related technical risk are introduced. The most importing their influence on the competitiveness of a design. main parameters on the total performance of a ship this lecture, the design changes are dealt with by si learn to model complex systems properly so that the	The lecture focusses on o design and the consec mple models or formula	the influen cutive proce e. The stud	ce of alternate ess elements. ent shall furthe
	The lecture continues with an introduction into the design phase to a building contract. Further, metho relevant information at different levens of granulari following topics are adressed:	ds are introduced to ge	nerate buld	ing specficatio
Knowledge	<ul> <li>Structure of a building specification</li> <li>Determination of Light Ship Weight and Deadweig Components</li> <li>Design of main section and hull form</li> <li>Design of aftbody lines and manoevering devices</li> <li>Design of main propulsion plant</li> <li>Design of subdivision</li> <li>Determination of limiting GMrequ- Curves</li> <li>Scantlings of most improtant structural members</li> <li>Longitudinal strength</li> <li>Outfitting Components</li> <li>Relevant rules and regulations</li> </ul>	ht		
Skills	The student is made familiar with the basic design p the lecture is that the student shall be able to ca comparison fulfilling typical contract requirements with the basic design methods to determine the fun with respect to fulfillment procedures of the contract Design" the relevant methods to determine and ju- treated.	arry out a concept des within the Marine Envir damantal technical char ct values. Based on the	ign based conment. Th racteristics of lecture "Pr	on a vessel le lecture dea of a ship desig inciples of Sh
Personal Competence				
Social Competence	The students learns to prepare technical matters customer against his competitors.	-	·	·
Autonomy	The students learns to prepare technical matters customer against his competitors.	in such a way the he o	can persua	ie his potanti
	Independent Study Time 124, Study Time in Lecture	9 56		
Credit points	6			
Examination	Written exam			
Examination duration				



and scale	180 min
A :	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:

Course L1262: Ship Des	urse L1262: Ship Design	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1264: Ship Design	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	
Literature	



## **Specialization Process Engineering**

Process engineering is the engineering discipline that conducts research into, develops, and realizes material change processes. It deals as a cross-sectional science with the conversion of materials in their nature, their properties, or their composition by means of physical, chemical, and biological processes with a view to producing usable intermediate or end products such as fuels, sugar, synthetics, proteins, cosmetics, dyestuffs, alcohols, plant protection products, or medications.

To achieve these targets, the process engineering study program aims to enable students to recognize and formulate laws by means of which apparatus, machinery, and entire manufacturing plants can be planned, calculated, designed, built, and operated. The product qualities required are to be achieved by means of safe and environmentally compatible processes and a rational use of energy and raw materials.

Courses				
Title		Тур	Hrs/wk	СР
	ingineering/Bioprocess Engineering (L0829)	Lecture	2 2	1 2
Fundamentals of material		Lecture	2	2
	Prof. Michael Schlüter			
Admissio Requirement	None			
Recommende Previous Knowledg	nono			
Educational Objective	After taking part successfully, students hav	e reached the following l	earning results	
Professiona Competenc Knowledg	<ul> <li>After passing this module the students hav</li> <li>give an overview of the most import</li> <li>explain some working methods for</li> </ul>	ant fields on process and		eering,
Skill	<ul> <li>After passing this module the students sho</li> <li>list and outline the most important fi</li> <li>name the most important working engineering,</li> <li>read and prepare an engineering d</li> <li>explain the most important technolo</li> <li>scheme typical chemical and big pointers.</li> </ul>	elds of process engineer approaches or method rawing, ogies for wastewater and	s of the different fi exhaust air treatme	nt
Personal Competenc	The students are able to			
	<ul> <li>work out results in groups and docu</li> <li>provide appropriate feedback and h</li> </ul>		own performance o	onstructively.



Autonomy The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering.

Workload in Hours	Independent Study Time 34, Study Time in Lecture 56
Credit points	3
	Written exam
Examination duration and scale	90 min
v	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course L0829: Introduction into Process Engineering/Bioprocess Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des SD V	
Language	DE	
Cycle	WiSe	
Content	Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.	
Literature	s. StudIP	



Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction</li> <li>Atomic structure and bonding</li> <li>Structure of solids</li> <li>Miller indices</li> <li>Imperfections in solids</li> <li>Texture</li> <li>Diffusion</li> <li>Mechanical properties</li> <li>Dislocations and strengthening mechanisms</li> <li>Phase transformations</li> <li>Phase diagrams, iron-carbon phase diagram</li> <li>Metallic materials</li> <li>Corrosion</li> <li>Polymeric materials</li> <li>Ceramic materials</li> </ul>
Literature	<ul> <li>Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012.</li> <li>Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009.</li> <li>Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008.</li> <li>Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: ei Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013.</li> <li>Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.</li> </ul>

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Courooo					
Courses		Tur	Line hold	0.0	
Title Physical Chemistry (L0833)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2	
Physical Chemistry (L0835)		Practical Course	2	1	
Module Responsible	Prof. Hans-Ulrich Moritz				
Admission Requirements	None				
Recommended Previous Knowledge	Contents of the previous modules inorga	nic chemistry, physics for engir	neers and math	ematics I-III.	
Educational Objectives	After taking part successfully, students ha	ave reached the following learn	ing results		
Professional Competence					
	The students are able,				
	-to repeat the basic concepts of physical	chemistry			
Knowledge	-to describe and summarize the underlyi	ng concepts of mass-, heat- an	nd momentum tr	ansfer.	
	- to interpret phase diagrams and affiliate	kinetic rate laws.			
	The students are able to				
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.				
Skills	- assess new applications with respect to environmental sustainability.				
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kinet calculations.				
Personal Competence					
	The students are able to plan, prepare guidelines in small groups.	, conduct and document expe	eriments accord	ling to scienti	
Social Competence	The students are able to reflect their sub fellow students and faculty.	ject-specific knowledge orally	in a team and t	o discuss it w	
Autonomy	Students are able to assess their knowldege continuously on their own by exemplified practice Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.				
Workload in Hours	Independent Study Time 34, Study Time	in Lecture 56			
Credit points					
Examination	Written exam				
Examination duration and scale	180 min				
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulso General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory				



Course L0833: Physical	Chemistry
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces
Literature	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>

Б



Course L0	835: Physical Chemistry
Тур	Practical Course
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are: Reaction kinetics Freezing-point depression (cryoscopy) Electrical mobility of ions Viscosimetry Heat of neutralization Surface tension
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter http://www.chemie.uni- hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
·	Basic knowledge in electrical engineering			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Childrente and a hole to calve similar matching along or in a group and to present the results accord		s accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Core qualification: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory

## Technomathematics: Specialisation II. Informatics: Elective Compulsory

TUHH

Course L0321: Compute	er Engineering		
Тур	Lecture		
Hrs/wk			
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer Engineering		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses					
Title			Тур	Hrs/wk	СР
Fundamentals of Fluid Mech Fluid Mechanics for Process	, ,		Lecture Recitation Section (large)	2 2	4 2
	Prof. Michael Schlüter				
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part successf	lly, students have re	ached the following learning	g results	
Professional Competence					
Knowledge	<ul> <li>Students are able to:</li> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in proces engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physica boundary conditions</li> </ul>				
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>				
Personal Competence					
Social Competence	<ul> <li>The students</li> <li>are capable to gather information from subject related, professional publications and relate the information to the context of the lecture and</li> <li>able to work together on subject related tasks in small groups. They are able to present the results effectively in English (e.g. during small group exercises)</li> <li>are able to work out solutions for exercises by themselves, to discuss the solutions orally and present the results.</li> </ul>				
Autonomy	<ul> <li>The students are able to</li> <li>search further literature for each topic and to expand their knowledge with this literature,</li> <li>work on their exercises by their own and to evaluate their actual knowledge with the feedback</li> </ul>				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination					
Examination duration and scale					
	General Engineering Sci General Engineering S Engineering: Compulsory	nce (German progra cience (German p	m): Specialisation Process m): Specialisation Bioproce program): Specialisation ram, 7 semester): Specialis	ss Engineer Energy and	ing: Compulsor d Enviromenta



Course L0091: Fundamentals of Fluid Mechanics			
Тур	Typ Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>fluid properties</li> <li>hydrostatic</li> <li>overall balances - theory of streamline</li> <li>overall balances- conservation equations</li> <li>differential balances - Navier Stokes equations</li> <li>irrotational flows - Potenzialströmungen</li> <li>flow around bodies - theory of physical similarity</li> <li>turbulent flows</li> <li>compressible flows</li> </ul>		
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011</li> </ol>		



Course L0092: Fluid Med	chanics for Process Engineering		
Typ Recitation Section (large)			
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	SoSe		
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.		
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007</li> <li>Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011</li> </ol>		



Courses				
<b>Title</b> Phase Equilibria Thermodyn Phase Equilibria Thermodyn Phase Equilibria Thermodyn	amics (L0140)	<b>Typ</b> Lecture Recitation Section (smal Recitation Section (large		<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermo	dynamics I and II		
Educational Objectives	After taking part successfully, students have	ve reached the following learning	ng results	
Professional Competence	<ul> <li>Starting from the year's basics of th</li> </ul>		o wo the o wo o the	
Knowledge	<ul> <li>Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria.</li> <li>They learn how state variables are influenced by the mixing of compounds and learn concept to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibrian Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	<ul> <li>Applying their knowledge, the s determination of the equilibrium sta</li> <li>The students know models which equilibrium state and they are able</li> <li>For specific applications, they a properties of compounds as well a</li> <li>Beside pure compound propertie mixtures.</li> <li>The students know how to visual interpret the occurring phenomena</li> <li>Based on their knowledge, the stut the basis for many separation and</li> </ul>	ate and know how to simplify the can be used to determine the p to solve the resulting mathema re able to self-reliantly find s model parameters in literature s the students are capable of alize phase equilibria graphic the students are able to understand for	ese equations properties of the trical relations necessary p e sources. describing the cally and the undamental c	s meaningfully he system in t s. hysico-chemic he properties y know how oncepts that a
Personal Competence Social Competence	The students are able to work in small g them oraly to the tutors and other students		ling problems	s and to prese
Autonomy	<ul> <li>The students are able to find necessary information self-reliantly in literature sources and to judge their quality.</li> <li>During the semester the students are able to check their learning progress continuously in exercises. Based on this knowledge the students can adept their learning process.</li> </ul>			
Workload in Hours				



Credit.points Examination	₩ritten exam		
Examination duration and scale	20 minutes; theoretical questions and calculations		
•	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Process Engineering: Core qualification: Compulsory		

Course L0114: Phase Equilibria Thermodynamics				
Typ Lecture				
Hrs/wk	Hrs/wk 2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Irina Smirnova			
Language	DE			
Cycle	SoSe			
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: eaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>			
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid- Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>			



ourse L0140: Phase Ec	uilibria Thermodynamics				
Тур	Recitation Section (small)				
Hrs/wk	1				
СР					
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14				
Lecturer	Prof. Irina Smirnova				
Language	DE				
Cycle	SoSe				
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemica potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: equilibrium condition, binary systems</li> <li>Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>				
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. 6 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>				



Course L0142: Phase Ec	quilibria Thermodynamics			
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Irina Smirnova			
Language	DE			
Cycle	SoSe			
Content	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>			
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid- Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>			



<b>Title</b> Signals and Systems (L043)		<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 4
Signals and Systems (L043)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3 The modul is an introduction to the theory of signals and systems. Good knowledge in maths a covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation (Fourier series, Fourier transform, Laplace transform) is useful but not required.			
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin 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.			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant system 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 asset the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific pro	blems.		
Autonomy	The students are able to acquire relevant control their level of knowledge during the clicker system.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
	Written exam			
Examination	190 min			
Examination Examination duration and scale	General Engineering Science (German pr	rogram): Specialisation Electrical	Engineering	: Compulsory



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	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 Materials in Engineering Sciences: 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 Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering. Core qualification. Compulsory
Tonowing Curricula	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



urse L0432: Signals a	nd Systems				
Тур	Lecture				
Hrs/wk	3				
СР					
	Independent Study Time 78, Study Time in Lecture 42				
	Prof. Gerhard Bauch				
Language					
Cycle	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>				
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>				



course L0433: Signals and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Engineering - Fu	indamentals (L0841)	Lecture	2	3
Bioprocess Engineering- Fu		Recitation Section (large	,	1
Bioprocess Engineering - Fu	Indamental Practical Course (L0843)	Practical Course	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	none, module "organic chemistry", module	e "fundamentals for process eng	gineering"	
Educational Objectives	After taking part successfully, students have	ve reached the following learning	ng results	
Professional				
Competence				
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to class different types of kinetics for enzymes and microorganisms, as well as to differentiate different types inhibition. The parameters of stoichiometry and rheology can be named and mass transport process in bioreactors can be explained. The students are capable to explain fundamental bioproce management, sterilization technology and downstream processing in detail.			
Social Competence	<ul> <li>propose solutions to complicated biotechnological problems and to deduce the correspondi models</li> <li>to explore new knowledge resources and to apply the newly gained contents</li> <li>identify scientific problems with concrete industrial use and to formulate solutions.</li> <li>to document and discuss their procedures as well as results in a scientific manner</li> </ul>			
	independently by organizing their workflo			
	Independent Study Time 96, Study Time in	n Lecture 84		
Credit points				
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German pr General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German pr Compulsory	ogram): Specialisation Bioproc program, 7 semester): Special	ess Engineeri isation Proce	ing: Compulso ss Engineerin



	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (English program): Specialisation Process Engineering: Compulsory					
-	General Engineering Science (English program, 7 semester): Specialisation Process Engineerir					
Following Curricula	Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering					
	Compulsory					
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory					
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory					
	Biomedical Engineering: Specialisation Management and Business Administration: Elective					
	Compulsory					
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective					
	Compulsory					
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory					
	Process Engineering: Core qualification: Compulsory					

Course L0841: Bioprocess Engineering - Fundamentals					
Тур	Lecture				
Hrs/wk	2				
CP					
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng				
Language	DE				
Cycle	SoSe				
Content	<ul> <li>Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture</li> <li>Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese)</li> <li>Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese)</li> <li>Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)</li> <li>Kinetic of subtrate consumption and product formation (Prof. Zeng)</li> <li>Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)</li> <li>Transport process in a bioreactor (Prof. Zeng)</li> <li>Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)</li> <li>Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)</li> </ul>				
	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> </ul>				



Тур	Recitation Section (large)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	<ol> <li>Enzymatic kinetics (Prof. Liese)</li> <li>Stoichiometry I + II (Prof. Liese)</li> <li>Microbial Kinetics I+II (Prof. Zeng)</li> <li>Rheology (Prof. Liese)</li> <li>Mass transfer in bioprocess (Prof. Zeng)</li> <li>Continuous culture (Chemostat) (Prof. Zeng)</li> <li>Sterilisation (Prof. Zeng)</li> <li>Downstream processing (Prof. Liese)</li> <li>Repetition (Reserve) (Prof. Liese, Prof. Zeng)</li> </ol>
Literature	siehe Vorlesung

Course L0843: Bioproce	ss Engineering - Fundamental Practical Course
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
	In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out. The students document their experiments and results in a protocol.
Literature	Skript

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Module M0538: He	at and Mass Transfer			
Courses				
Title Heat and Mass Transfer (L0101) Heat and Mass Transfer (L0102)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 2 2
Heat and Mass Transfer (L	868)	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynai	nics		
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of explain procedural apparatus (e.g. heat explain processes).</li> <li>They are capable of distinguish a namely heat conduction, heat transformation.</li> <li>The students have the ability to explain the students have the students have the ability to explain the students have th</li></ul>	Achanger, chemical reactors). nd characterize different kinds or sfer and thermal radiation. Explain the physical basis for ma and quantitative by using suitable	f heat transf ss transfer mass trans	fer mechanisn in detail and fer theories.
Skills	<ul> <li>The students are able to set rease using the gained knowledge an respectively.</li> <li>They are capable to solve specitemperature alteration in fluids) an</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish betwee They can use this knowledge for column, rectification column).</li> <li>In this context, the students are car mass exchanger for a specific apprespectively.</li> <li>In addition, they can calculate both apparatus.</li> <li>The students are capable to conn of other courses (In particular the process engineering) to solve condition.</li> </ul>	d to balance the correspondin fic heat transfer problems (e.g. d to calculate the corresponding h e students can execute scaling u een diffusion, convective mass tr r the description and design of apable to choose and design fund plication considering their advan h, steady-state and non-steady-state ect their knowledge obtained in t e courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flo emical reactor al processes d mass transfe (e.g. extraction pes of heat ar disadvantage es in procedur with knowlego
Personal Competence	<ul> <li>The students are capable to work results orally in a reasonable many</li> </ul>		n teams and	d to present th
	<ul> <li>The students are able to find and e</li> <li>They are able to prove their le procedure continuously (clicker-state)</li> </ul>	vel of knowledge during the c	ourse with	accompanyir



Autonomy	control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory



Course L0101: Heat and Mass Transfer		
Typ Lecture		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	<ol> <li>Heat transfer         <ul> <li>Introduction, one-dimensional heat conduction</li> <li>Convective heat transfer</li> <li>Multidimensional heat conduction</li> <li>Non-steady heat conduction</li> <li>Thermal radiation</li> </ul> </li> <li>Mass transfer         <ul> <li>one-way diffusion, equimolar countercurrent diffusion</li> <li>boundary layer theory, non-steady mass transfer</li> <li>Heat and mass transfer single particle/ fixed bed</li> <li>Mass transfer and chemical reactions</li> </ul> </li> </ol>	
Literature	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>	

Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1868: Heat and Mass Transfer	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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Courses				
<b>Title</b> Thermal Separation Process	ses (L0118)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 2
Thermal Separation Process		Recitation Section (small)	2	2
Thermal Separation Process		Recitation Section (large)	1	1
Separation Processes (L115	59)	Practical Course	1	1
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Recommended requirements: Thermodynan	nics III		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>distillation, extraction, and adsorption</li> <li>The students develop an understan process, the estimation of the energy and the selection of separation system</li> <li>They have good knowledge of design</li> </ul>	ding for the course of concen y demand of a process, the po ms	ssibilities o	f energy saving
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a separation process and can close the associated energy and material balances</li> <li>The students can use different graphical methods for the designing of a separation p and define the amount of theoretical stages required</li> <li>They can select and design a basic type of thermal separation process for a given case on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties appropriate sources (diagrams and tables)</li> <li>They can calculate continuous and discontinuous processes</li> <li>The students are able to prove their theoretical knowledge in the experimental lab work.</li> <li>The students are able to discuss the theoretical background and the content experimental work with the teachers in colloquium.</li> </ul>		aration proces ven case base properties fro ab work. content of th ectures and us	
Personal Competence	• The students can work technical a	ssignments in small groups a	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out prodivision of labor between them. The scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to obta themselves and assess their quality</li> <li>The students can proof the state of th this way control their learning proces</li> </ul>	neir knowledge with exam rese		



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	Energy and Environmental Engineering: ("ore gualitication: ("ompulsory



ourse L0118: Thermal	Separation Processes
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg., 6th ed., McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technische Chemie</li> </ul>



Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th e McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



ourse L0141: Thermal	Separation Processes		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann''s Enzyklopädie der Technischen Chemie</li> </ul>		



Тур	Practical Course		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
	Compulsory attendence of the colloquia of all experiments and compulsory report.		
	Prof. Irina Smirnova		
Language			
Cycle			
	<ul> <li>The students work on eight different experiments in this practical course. For every one of the eighexperiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.</li> <li>The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback or their own reports and level of scientific writing so they can increase their capabilities in this area.</li> <li>Topics of the practical course: <ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Selection of separation processes</li> <li>Selection of separation processes</li> </ul> </li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



Module M0892: Ch	emical Reaction Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fundamentals) (L0204)		Lecture	2	2
-	ring (Fundamentals) (L0244) ical Engineering (Fundamentals) (L0221)	Recitation Section (large) Practical Course	2 2	2 2
Module Responsible				
Admission				
	Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics as well as computational methods for engineers.			
Educational Objectives	After taking part successfully, students hav	ve reached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemical reaction engineering. They are able point out differences between thermodynamical and kinetical processes. The students have a stro ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their propertie After successful completion of the module, students are able to:			
Skills	<ul> <li>apply different computational methods to dimension isothermal and non-isothermal ideal reactors,</li> <li>determine and compute stable operation points for these reactors ,</li> <li>conduct experiments on a lab-scale pilot plants and document these according to scient guidelines.</li> </ul>			
Personal Competence				
Social Competence	After successful completition of the lab-course the students have a strong ability to organ themselfes in small groups to solve issues in chemical reaction engineering. The students can discutheir subject related knowledge among each other and with their teachers.			
Autonomy	The students are able to obtain further info can apply their knowldege discretely to pla			nously. Stude
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
_	<ul> <li>General Engineering Science (German program): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program): Specialisation Bioprocess Engineering: Compuls</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineeri</li> <li>Compulsory</li> <li>Bioprocess Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory</li> <li>General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory</li> <li>General Engineering Science (English program): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (English program): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineeri</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineeri</li> </ul>			

Course L0204: Chemical Reaction Engineering (Fundamentals)	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28



Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Content	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH



	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
Literature	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

	I Reaction Engineering (Fundamentals) Recitation Section (large)
Hrs/wk	
CP	
	 Independent Study Time 32, Study Time in Lecture 28
	Prof. Raimund Horn, Dr. Oliver Korup
Language	
Cycle	
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentration (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationar and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes is complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxi- first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entrop Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, var Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reaction elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, ra of change of species mole number, Arrhenius-equation, activation energy and pre-exponential fact for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhle number, differential and integral method of kinetic analysis, laboratory reactors for kinet



Content	measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors. Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
Literature	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons 2010



Course L0221: Experime	ental Course Chemical Engineering (Fundamentals)
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch
Language	DE/EN
Cycle	SoSe
	Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors: * Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate
	*CSTR - Residence time distribution, reaction
	*CSTR in Series - Residence time distribution, reaction
	* Plug Flow Reactor - Residence time distribution, reaction
Content	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
	Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
	Praktikumsskript
Literature	Skript Chemische Verfahrenstechnik 1 (F.Keil)



Courses							
Title         Practical Course: Measurement and Control Systems (L1119)         Measurement Technology for Mechanical and Process Engineers (L1116)         Measurement Technology for Mechanical and Process Engineers (L1118)		<b>Typ</b> Practical Course Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1			
Module Responsible							
Admission Requirements	None						
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ectrical engineering					
Educational Objectives	After taking part successfully, students have re	ached the following learning	results				
Professional Competence							
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).						
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-					
	They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)						
Skills	Students can select suitable measuring measurement devices in practice. The students are able to orally explain issue solution approaches as well as place the issue	es in the subject area of me	asurement	technology a			
Personal Competence	Students can arrive at work results in groups a	nd document them in a comm	non report.				
Social Competence							
	Students are able to familiarize themselves with new measurement technologies.						
	Independent Study Time 110, Study Time in Le	ecture 70					
Credit points	6 Written exam						
Examination Examination duration and scale	105 minutes						
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra	program): Specialisation m): Specialisation Biomedica m): Specialisation Process E program, 7 semester): Sp m, 7 semester): Specialisatio am, 7 semester): Specialisatio	Mechanica al Engineeri ingineering: becialisatior on Mechanic on Biomedic	I Engineerin ng: Compulsor Compulsory Energy an cal Engineerin cal Engineerin			
	Compulsory Energy and Environmental Engineering: Core						



Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Process Engineering: Core qualification: Compulsory



Course L1119: Practica	Course: Measurement and Control Systems
	Practical Course
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	DE
	WiSe/SoSe
·	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



ourse L1116: Measure	ment Technology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28 Dr. Sven Krause
Language	
Cycle	
	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Content	2.6 Data Transmission
Content	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springe 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 97 3486217940.



Course L1118: Measure	rse L1118: Measurement Technology for Mechanical and Process Engineers				
Тур	Recitation Section (large)				
Hrs/wk	1				
CP	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Dr. Sven Krause				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

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Courses						
Title Introduction to Control Syste Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2		
Module Responsible		· · · · ·				
Admission						
Requirements	None					
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m		
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results			
Professional Competence						
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>					
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>					
Personal Competence						
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate					
Autonomy	their controller designs 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						
	Written exam					
Examination duration and scale	120 min					
	General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German pr	program, 7 semester): Special	isation Con			

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Assignment for the Following Curricula	Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory



		fication: Comp cialisation III. E	,	Science: Elective	e Compu	sory		
Theoretical	Mechanical	Engineering:	Technical	Complementary	Course	Core	Studies:	Elective
Compulsor	у							
Process En	gineering: Co	re qualification	: Compulso	ry				

_	Lead of the second s
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Signals and systems   Linear systems, differential equations and transfer functions  First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  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  Root locus techniques  Root locus plots Not locus design of PID controllers  Frequency response techniques  Not locus techniques  Not locus 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  Time delay systems Root locus and frequency response of time delay systems Simith predictor  Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers  Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	Irse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environm Environmental Technologie		Practical Course Lecture	1 2	1 2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chem	istry and biology		
Educational Objectives	After taking part successfully, students ha	ve reached the following learr	ing results	
Professional Competence				
Knowledge	With the completion of this modul the technology. They are able to describe the give an overview of scientific disciplines is methods.	ne behaviour of chemicals in	the environmer	nt. Students ca
Skills	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential or pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and			
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems.			
Workload in Hours	Independent Study Time 48, Study Time	n Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour			
Assignment for the Following Curricula			eering: Electi n Energy au ss Engineerin ess Engineerin d Enviromen eering: Electi nd Enviromen ss Engineerin	

#### Process Engineering: Core qualification: Elective Compulsory

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Course L1387: Practical	ourse L1387: Practical Exercise Environmental Technology		
Тур	Practical Course		
Hrs/wk			
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Joachim Gerth		
Language	DE		
Cycle	SoSe		
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.		
Literature	F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515		

Course L0326: Environn	ourse L0326: Environmental Technologie	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)	

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Courses				
Title		Тур	Hrs/wk	СР
Process and Plant Engineeri Process and Plant Engineeri	,	Lecture Recitation Section (large)	2 1	2 2
Process and Plant Engineeri		Recitation Section (arge)	1	2
Module Responsible	Prof. Geora Fieg			
Admission	None			
	unit operation of thermal an dmechanical s	separation processes		
Recommended Previous Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence				
	students can:			
	classify and formulate blobal balance equa	ations of chemical processes		
Knowledge	specify linear component equations of con	nplex chemical processes		
	explain linear regression and data reconci	lliation problems		
	explain pfd-diagrams			
	students are capable of			
	- formulation of mass and energy balance	equations and estimation of prod	uct streams	
	- estimation of component streams of chemical plants using linear component balance models			
Skills	s - solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and th	e estimation of production costs		
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Examination Examination duration	written exam			
and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula			ng: Compulso ss Engineerin ss Engineerin n Energy ar ng: Compulsor Compulsory	



General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory

	and Plant Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	
	Prof. Georg Fieg
Language Cycle	
Content	<ol> <li>Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants         Engineering methods and tools         Mass and energy balances         Strategies of process synthesis         Graphical representation of processes         Multidimensional regression         Data reconciliation and data validation         Process Synthesis         Decision levels         Experimental process development         Reactor synthesis         Synthesis of separation processes (process alternatives and criteria for selection)         Integration of reaction systems/separation systems (interactions, recycle streams)         4. Process safety         Solution costs, capital costs, economic evaluation</li></ol>
	<ul> <li>S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679</li> <li>H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74</li> <li>Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157</li> <li>E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997</li> <li>M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916</li> <li>R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&amp;Co.KGaA, Weinheim, 2004</li> <li>J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988</li> <li>G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19</li> <li>G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306</li> <li>G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213</li> <li>G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133</li> <li>U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlur Blazek und Bergamann, Frankfurt, 2000</li> </ul>

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Literature	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
Literature	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
	G. Kaibel, Dissertation, TU München, 1987
	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
_	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process	ourse L0096: Process and Plant Engineering I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1214: Process	rse L1214: Process and Plant Engineering I	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L043	4)	Lecture	2	3
Particle Technology I (L043		Recitation Section (small)	1	1
Particle Technology I (L044	0)	Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous Knowledge				
	After taking part successfully, students have	reached the following learning	results	
Professional				
Competence				
	After successful completion of the module s	tudents are able to		
	<ul> <li>name and explain processes and up</li> </ul>	nit-operations of solids process	onaineorina	
Knowledge		•	• •	,
	Students are able to			
Skills	<ul> <li>choose and design apparatuses an solids properties of the product</li> </ul>	d processes for solids processir	ng according	g to the desir
Skills	<ul> <li>asses solids with respect to their bel</li> </ul>	navior in solids processing steps		
	<ul> <li>document their work scientifically.</li> </ul>	iation in conde proceeding clope	•	
Personal Competence				
-	The students are able to discuss scientific to		or scientific p	personal and
Personal Competence Social Competence	The students are able to discuss scientific to develop solutions for technical-scientific iss	ues in a group.		
-	The students are able to discuss scientific to develop solutions for technical-scientific iss	ues in a group.		
Social Competence Autonomy	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que	ues in a group. stions regarding solid particles i		
Social Competence Autonomy	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in	ues in a group. stions regarding solid particles i		
Social Competence Autonomy Workload in Hours Credit points	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in	ues in a group. stions regarding solid particles i		
Social Competence Autonomy Workload in Hours Credit points	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam	ues in a group. stions regarding solid particles i		
Social Competence Autonomy Workload in Hours Credit points Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes	ues in a group. stions regarding solid particles i		
Social Competence Autonomy Workload in Hours Credit points Examination Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes	ues in a group. stions regarding solid particles i Lecture 70	ndependent	ly.
Social Competence Autonomy Workload in Hours Credit points Examination Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces	ndependent ngineering: s Engineerir	dy. Compulsory
Social Competence Autonomy Workload in Hours Credit points Examination Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces	ndependent ngineering: s Engineerir	dy. Compulsory ng: Compuls
Social Competence Autonomy Workload in Hours Credit points Examination Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces program): Specialisation E	ndependent ngineering: s Engineerir nergy and	dy. Compulsory ng: Compuls Enviromer
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Social Competence Autonomy Workload in Hours Credit points Examination Examination	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces program): Specialisation E ogram, 7 semester): Specialisatio gram, 7 semester): Specialisatio	ndependent ngineering: s Engineerir nergy and ation Proces	dy. Compulsory ng: Compuls Enviromer s Engineeri
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Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory Bioprocess Engineering: Compulsory	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation compulsory	ndependent ngineering: s Engineerir nergy and ation Proces	dy. Compulsory ng: Compuls Enviromer s Engineeri
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Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory Bioprocess Engineering: Compulsory	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces: program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation i program, 7 semester): Specialisation program, 7 semester): Specialisation	ndependent ngineering: s Engineerir inergy and ation Proces on Bioproces becialisation	dy. Compulsory ng: Compulso Enviromer s Engineeri ss Engineeri Energy a g: Compulso
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Energy and Environmental Engineering: Co General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioproces program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation program): Specialisation Bioprocesse program): Specialisation E	ndependent ngineering: s Engineerin ation Proces on Bioproces becialisation s Engineerin nergy and	dy. Compulsory ng: Compulso Enviromer s Engineeri ss Engineeri Energy a g: Compulso Enviromer
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory Bioprocess Engineering: Core qualification: Energy and Environmental Engineering: Co General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioprocess program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation program): Specialisation Bioprocess program): Specialisation E program): Specialisation Process Er	ndependent ngineering: s Engineerin nergy and ation Proces on Bioproces becialisation s Engineerin nergy and ngineering: (	dy. Compulsory ng: Compuls Enviromer s Engineeri ss Engineeri Energy a g: Compulso Enviromer Compulsory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (English prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioprocess program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation program): Specialisation Bioprocess program): Specialisation E program): Specialisation Process Er	ndependent ngineering: s Engineerin nergy and ation Proces on Bioproces becialisation s Engineerin nergy and ngineering: (	dy. Compulsory ng: Compuls Enviromer s Engineeri ss Engineeri Energy a g: Compulso Enviromer Compulsory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Energy and Environmental Engineering: Co General Engineering Science (English prog General Engineering Science (English prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioprocess program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation i program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation program): Specialisation Bioprocess program): Specialisation E program): Specialisation E program, 7 semester): Specialisation E program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation	ndependent ngineering: s Engineerin energy and ation Proces on Bioproces becialisation s Engineerin nergy and ngineering: C ation Proces	dy. Compulsory ng: Compuls Enviromer s Engineeri Energy a g: Compulsor Enviromer Compulsory s Engineeri
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	The students are able to discuss scientific to develop solutions for technical-scientific iss Students are able to analyze and solve que Independent Study Time 110, Study Time in 6 Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (English prog	ues in a group. stions regarding solid particles i Lecture 70 gram): Specialisation Process E gram): Specialisation Bioprocess program): Specialisation E ogram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Specialisation i program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation program): Specialisation Bioprocess program): Specialisation E program): Specialisation E program, 7 semester): Specialisation E program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation	ndependent ngineering: s Engineerir energy and ation Proces on Bioproces becialisation s Engineerin nergy and ngineering: C ation Proces	dy. Compulsory ng: Compuls Enviromer s Engineeri Energy a g: Compulsor Enviromer Compulsory s Engineeri



### Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology I	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Osena 10440 Devilate 1	Parkan I.
Course L0440: Particle	lechnology I
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Module M0829: Fo	undations of Management				
Courses					
Title Introduction to Management (L0880)		<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3	
Project Entrepreneurship (L		Project-/problem-based Learning	2	3	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness			
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	g results		
Professional Competence					
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>				
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under rise</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods for marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			y are able to and under risk sems	
Personal Competence					
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>				
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>				
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70			
Credit points					
	Subject theoretical and practical work				



and scale				
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Bioprocess Engineering, Compution, General Engineering Science (German program): Specialisation Energy and Environmenta			
	Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Civil- and Enviromenta			
	Engeneering: Compulsory			
	General Engineering Science (German program): Specialisation Mechanical Engineering			
	Compulsory			
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering			
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 Computer Science Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 Biomechanics: 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 Materials in Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory			
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering			
Following Curricula				
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromenta			
	Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory Constral Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture			
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Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering
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General Engineering Science (English program, 7 semester): Specialisation Civil Engineering Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
Focus Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering
Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory



Tvn	Lecture
Hrs/wk	
CP	
	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathr Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Cha Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateg information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeir Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> <li>Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.</li> </ul>



Course L0882: Project E	ntrepreneurship
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Dr. Maximilian Mülke, Tobias Vlcek
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0891: Inf	ormatics for Process Engir	ieers			
Courses					
Title	Тур		Hrs/wk	СР	
Informatics for Process Eng Informatics for Process Eng	Lecture	n Section (small)	2 2	2 2	
Numeric and Matlab (L0125)		Practical	( )	2	2
Module Responsible	Dr. Marcus Venzke				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in using MS Windo	WS.			
Educational Objectives	After taking part successfully, student	s have reached the fo	llowing learning	results	
Professional Competence					
	Students can describe procedural an	d object-oriented cond	cepts.		
Knowledge					
Skills	Students are capable of object-oriented programming in the programing language Java and of solvi mathematic questions by using Matlab. Students are capable of developing concepts (simple algorithms) to solve technical questions.				
Personal Competence Social Competence	Students are able to work out solutions together in small groups.				
Autonomy	Students are able to assess acquired	skills by applying it in	practice.		
Workload in Hours	Independent Study Time 96, Study Ti	me in Lecture 84			
Credit points	6				
	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Electi Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy at Enviromental Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory			n Energy and ss Engineering eering: Elective nd Enviromenta	



Course L0836: Informati	cs for Process Engineers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	Introduction to object-oriented modelling and programming exemplified with Java <ul> <li>Objects, classes</li> <li>Methods, properties</li> <li>Inheritance</li> <li>Basics of the language Java</li> <li>Sample application: Simulation of an electricity network</li> <li>2D graphics</li> <li>Events and Controls</li> </ul>
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison- Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/



Course L0837: Informati	cs for Process Engineers			
Тур	Recitation Section (small)			
Hrs/wk				
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Marcus Venzke			
Language	DE			
Cycle	SoSe			
Content	In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor.			
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison- Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/			

Course L0125: Numeric	and Matlab
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>
Literature	Literatur (Software-Teil): <ol> <li>Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007</li> <li>Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de</li> <li>Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>

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Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment	(L0860)	Lecture	2	2
Environmental Assessment	(L1054)	Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chem	istry and biology		
Educational Objectives	After taking part successfully, students ha	we reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competer in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertaintie and difficulties with their measurement.			
Skills	The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigatin environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the databas Ecolnvent. After finishing the course the students have the competence to critically judge researc results or other publications on environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific ar multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitive and consciousness towards these subjects are raised and which helps to raise their awareness their future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process a carry out independent scientific work. The and are able to judge results of other pub	ey can solve an environmental pro		
Workload in Hours	Independent Study Time 48, Study Time i	in Lecture 42		
Credit points				
-	Written exam			
Examination duration and scale	1 hour written exam			
	General Engineering Science (Germ Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Elective Compulsory General Engineering Science (German p Elective Compulsory Bioprocess Engineering: Core qualification Energy and Environmental Engineering:	n program): Specialisation Proc an program, 7 semester): Sp program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation	cess Engine pecialisation ation Proces	eering: Electi Energy a ss Engineerin
Assignment for the		considering and an only and a		

#### TUHH Hamburg University of Technolog

Following Curricula	General Engineering Science (English program): Specialisation Energy and Enviromental		
	Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Process Engineering: Elective		
	Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental		
	Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:		
	Elective Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
	Elective Compulsory		
	Process Engineering: Core qualification: Elective Compulsory		
	Process Engineering: Core qualification: Compulsory		

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
Content	Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment , SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	



Course L1054: Environmental Assessment		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE	
Cycle	SoSe	
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject- specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	Power point Präsentationen	

## Thesis

Courses			
Title	Тур	Hrs/wk	CP
Module Responsible	Professoren der TUHH		
Admission Requirements	According to General Regulations §21 (1):		
Recommended Previous Knowledge			
	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	<ul> <li>The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods).</li> <li>On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise.</li> <li>The students are able to outline the state of research on a selected issue in their subject area.</li> </ul>		
Skills	<ul> <li>The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems.</li> <li>With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions.</li> <li>The students can take up a critical position on the findings of their own research work from specialized perspective.</li> </ul>		
Personal Competence			
Social Competence	<ul> <li>Both in writing and orally the students can outline a scientific issue for an expert audier accurately, understandably and in a structured way.</li> <li>The students can deal with issues in an expert discussion and answer them in a manner tha appropriate to the addressees. In doing so they can uphold their own assessments a viewpoints convincingly.</li> </ul>		
Autonomy	<ul> <li>The students are capable of structuring an extensive work process in terms of time and dealing with an issue within a specified time frame.</li> <li>The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.</li> <li>The students can apply the essential techniques of scientific work to research of their own.</li> </ul>		
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0		
Credit points			
Examination	Thesis		
Examination duration and scale	According to General Regulations		

Assignment for the Following Curricula Ge Co Co Co Log Me Me Na Teo xx:	vil- and Environmental Engineering: Thesis: Compulsory opprocess Engineering: Thesis: Compulsory extrical Engineering: Thesis: Compulsory eergy and Environmental Engineering: Thesis: Compulsory eneral Engineering Science (English program): Thesis: Compulsory eneral Engineering Science (English program, 7 semester): Thesis: Compulsory omputational Science and Engineering: Thesis: Compulsory gistics and Mobility: Thesis: Compulsory echanical Engineering: Thesis: Compulsory echanical Engineering: Thesis: Compulsory echanical Engineering: Thesis: Compulsory echantorics: Thesis: Compulsory exal Architecture: Thesis: Compulsory chnomathematics: Thesis: Compulsory : Thesis: Compulsory
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