## **Module Manual**

Bachelor of Science (B.Sc.)

# General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2017

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### **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**

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

#### Graduates are able to

- · Collaborate with both English and German speaking specialists in other disciplines
- · 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.

## Core qualification

Module M0701: C	hemistry (GES)			
Courses				
Title Chemistry (GES) I (L0467)	<b>Typ</b> Lecture		Hrs/wk	<b>CP</b> 2
Chemistry (GES) I (L0478) Chemistry (GES) II (L0469) Chemistry (GES) II (L0479)	Recitation Section Lecture Recitation Section	. •	1 2 1	1 2 1
Module Responsible		. 3 /		
Admission Requirements	INONE			
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following le	earning	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 and chemical compounds. On this basis, they are capable of explaining, choosing and applying specific 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 their approaches.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
	Written exam			
Examination duration and scale	1 1 20 min			
	General Engineering Science (English program): Core qualification: C General Engineering Science (English program, 7 semester): Core qu			sory

Course L0467: Chemistry (GES) I		
<b>Typ</b> Lecture		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
	Dr. Christoph Wutz	
Language		
Cycle		
Content	- Structure of matter  - Periodic table  - Electronegativity  - Chemical bonds  - Solid compounds and solutions  - Chemistry of water  - Chemical reactions and equilibria  - Acid-base reactions  - Redox reactions	
Literature	<ul> <li>Gallagher, Ingram: Complete Chemistry (Oxford University Press)</li> <li>Corwin: Introductory Chemistry (Pearson)</li> <li>Burrows, Parsons, Price, Holman: Chemistry3 (Oxford University Press)</li> </ul>	

Course L0478: Chemist	ourse L0478: Chemistry (GES) I		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Christoph Wutz		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0469: Chemist	Course L0469: Chemistry (GES) 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	EN		
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	<ul> <li>Gallagher, Ingram: Complete Chemistry (Oxford University Press)</li> <li>Corwin: Introductory Chemistry (Pearson)</li> <li>Burrows, Parsons, Price, Holman: Chemistry 3 (Oxford University Press)</li> </ul>		

Course L0479: Chemist	urse L0479: Chemistry (GES) II	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Christoph Wutz	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1121: P	rogramming in C				
Courses					
Title Programming in C (L0083) Programming in C (L1488)		<b>Typ</b> Lecture Practical Course	Hrs/wk 1 1	<b>CP</b> 1 1	
Module Responsible	Prof. Sieafried Rump				
Admission Requirements					
Recommended	Elementary PC handling skills				
	Elementary mathematical skills				
<b>Educational Objectives</b>	After taking part successfully, students have re	ached the following lear	ning results		
Professional Competence					
	The students know by heart the basic syntax of purpose.	f C programming as well	as its meaning, i	intent and	
	They know the fundamental components and p based on C programming and can explain them		procedural progra	amming	
Knowledge	basic data types (integers, floating point numbers, characters)     advanced data types (pointers, arrays, strings, composed data types, type conversion)     operators (arithmetical operations, logical operations, bit operations)     control flow (choice, loops, jumps, conditional compilation)     functions and macros     important standard libraries and functions     recursion     linked lists				
	The students are prepared for continuing programming lectures like object oriented programming in C++.				
	The students know how to use an integrated de so that they can write, store, compile and exec	•	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 problems on their own and can model and program their solutions in C language.				
	The students are able to solve selected exercises from other areas of their study like mathematics, mechanics, electrical engineering or physics with the aid of small C programs/-projects numerically.				
<b>Personal Competence</b>					
Social Competence	The students are able to work in small teams to programming errors and to present their results		ks, to identify and	d analyze	
•	They are able to explain simple phenomena to each other directly at the PC.				
	The students prepare themselves using the given teaching material and solve the given programming exercises on their own.				
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 the students inform themselves using the stated literature and / or by supplementary own research.				
Workload in Hours	I Independent Study Time 32, Study Time in Lect	ture 28			
Credit points					
Examination	Written elaboration				
Examination duration and scale	1-2 coding tasks weekly				
	General Engineering Science (German program General Engineering Science (German program General Engineering Science (English program) General Engineering Science (English program,	, 7 semester): Core qua : Core qualification: Con	lification: Compu npulsory	•	

Course L0083: Program	Course L0083: Programming in C		
Тур	Typ Lecture		
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	<ol> <li>C-Programming:         <ol> <li>basic data types (integers, floating point numbers, characters, boolean values)</li> <li>advanced data types (pointers, arrays, strings, composed data types, type conversion)</li> <li>operators (arithmetical operations, logical operations, bit operations)</li> <li>control flow (choice, loops, jumps, conditional compilation)</li> <li>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>important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)</li> <li>example programs for technical and mathematical applications</li> </ol> </li> </ol>		
Literature	Kernighan, Brian W (Ritchie, Dennis M.;) The C programming language ISBN: 9780131103702 Upper Saddle River, NJ [u.a.] : Prentice Hall PTR, 2009  Sedgewick, Robert Algorithms in C ISBN: 0201316633 Reading, Mass. [u.a.] : Addison-Wesley, 2007  Kaiser, Ulrich (Kecher, Christoph.;) C/C++: Von den Grundlagen zur professionellen Programmierung ISBN: 9783898428392 Bonn : Galileo Press, 2010  Wolf, Jürgen C von A bis Z : das umfassende Handbuch ISBN: 3836214113 Bonn : Galileo Press, 2009		

Course 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

Module M0736: L	inear Algebra			
Courses				
Title		Тур	Hrs/wk	CP
Linear Algebra (L0642) Linear Algebra (L0643)		Lecture Recitation Section (large)	4 2	4 2
Linear Algebra (L0645)		Recitation Section (large)	2	2
Module Responsible	Prof Marko Lindner	reditation because (cinally	_	_
Admission Requirements				
Recommended				
Previous Knowledge		and the fellowing lands		
Professional Objectives	After taking part successfully, students have	reached the following learning	results	
Competence				
Knowledge	<ul> <li>Students can name the basic concept appropriate examples.</li> <li>Students can discuss logical connections with the illustrating these connections with the They know proof strategies and can reconstructed.</li> </ul>	ections between these concep e help of examples.		_
Skills	<ul> <li>Students can model problems in line course. Moreover, they are capable of students are able to discover and studied in the course.</li> <li>For a given problem, the students car critically evaluate the results.</li> </ul>	f solving them by applying estab verify further logical connection	lished meth ons betwee	ods. n the concepts
Personal Competence				
Social Competence	- Students are able to work together (e.g. of teams (i.e., teams from different study pro- results appropriately (e.g. during exercise cl	grams and background knowle		
	<ul> <li>Students are capable of checking their uses pecify open questions precisely and know vertical students can put their knowledge in relations.</li> </ul>	where to get help in solving them	١.	own. They can
Autonomy	- Students have developed sufficient persistomanner on hard problems.			a goal-oriented
Workload in Hours	Independent Study Time 128, Study Time in	Lecture 112		
Credit points	8			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following Curricula		m): Ćore qualification: Compuls		sory

Course L0642: Linear Algebra	
Тур	Lecture
Hrs/wk	4
СР	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	WiSe
Content	Preliminaries  Vector spaces  Matrices and linear systems of equations  Scalar products and orthogonality  Basis transformation  Determinants  Eigen values
Literature	Strang: Linear Algebra Beutelsbacher: Lineare Algebra

Course L0643: Linear A	ourse L0643: Linear Algebra	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Francisco Javier Hoecker-Escuti	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0645: Linear Algebra	
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	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1081: M	lechanics I (GES)			
Courses				
Title Mechanics I (GES) (L1373) Mechanics I (GES) (L1374)		Typ Lecture Registration Section (Jarge)	Hrs/wk 2 3	<b>CP</b> 3 3
	1	Recitation Section (large)	3	3
	Prof. Radoslaw Iwankiewicz			1
Admission Requirements	None			
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students have i	reached the following learning	results	
Professional Competence				
Knowledge	<ol> <li>rigid bodies, structural elements and si</li> <li>Demonstrate sound techniques of cor real engineering systems;</li> <li>Promote the analytical and problemengineering problems effectively.</li> </ol>	ple structures, which are at rectural or engineering systems.  Inciples required to analyse the imple structures in equilibrium; instructing and solving idealises.  -solving skills required to solving skills required to solving idealises.	est (in equil The particules effects of foot and mathema	ibrium). Such a lar objectives of orces applied to tical models of
Skills	1. Apply the properties of two- and three elements and simple structures in equilibrium by drawir body are represented. 3. Analyse the external effects of forces three-dimensional equilibrium using the 4. Analyse the internal forces in trusses a 5. Solve problems of equilibrium with acces.  6. Determine mass centres and centroids	e-dimensional force systems to llibrium. ng its free-body diagram on wh acting on a single body or a sy e free-body diagram of the bod and beams. ount for dry friction.	nich all force	es acting on the
Personal Competence				İ
Social Competence	present them to others, - assess the team col	laboration and their own share	in it.	
Autonomy	Students are able to: - solve the problems strengths and weaknesses, e.g. with the aid o		of hints, - as	ssess their own
Workload in Hours	Independent Study Time 110, Study Time in L	Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	1.5 hours Statics: force systems, equilibrium,	mass center, friction, trusses, I	peams.	
	General Engineering Science (English progran General Engineering Science (English progran			sory

Course L1373: Mechanics I (GES)		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Radoslaw Iwankiewicz	
Language	EN	
Cycle	WiSe	
Content	<ol> <li>Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant.</li> <li>Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench.</li> <li>Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity.</li> <li>Equilibrium in two and three dimensions. Equations of equilibrium.</li> <li>Plane trusses: forces in members, the method of joints and the method of sections. Space trusses.</li> <li>Simple structures: frames and machines.</li> <li>Mass centers and centroids of lines, areas and volumes.</li> <li>Friction: dry friction, types of friction problems.</li> <li>Beams: internal effects- internal forces. Internal forces in curved-in-plane members.</li> <li>* Flexible cables.</li> <li>* Virtual work principle.</li> <li>* Denotes an additional topic.</li> </ol>	
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4 t Edition.</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3<sup>rd</sup> Edition.</li> </ol>	

Course L1374: Mechani	ics I (GES)
	Recitation Section (large)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	WiSe
Content	<ol> <li>Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant.</li> <li>Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench.</li> <li>Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity.</li> <li>Equilibrium in two and three dimensions. Equations of equilibrium.</li> <li>Plane trusses: forces in members, the method of joints and the method of sections. Space trusses.</li> <li>Simple structures: frames and machines.</li> <li>Mass centers and centroids of lines, areas and volumes.</li> <li>Friction: dry friction, types of friction problems.</li> <li>Beams: internal effects- internal forces. Internal forces in curved-in-plane members.</li> <li>* Flexible cables.</li> <li>* Virtual work principle.</li> <li>* Denotes an additional topic.</li> </ol>
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4 t Edition.</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3<sup>rd</sup> Edition.</li> </ol>

Module M1139: P	hysics for Engineers (G	ES)		
Courses				
<b>Title</b> Physics for Engineers (GES) Physics for Engineers (GES)		<b>Typ</b> Lecture Recitation Section (sma	Hrs/wk 2 II) 1	<b>CP</b> 3 1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, stu	dents have reached the following learning	ng results	
Professional Competence				
Knowledge	Students can explain fundament oscillations, waves, and optics.	tal topics and laws of physics such as	s in the areas	s of mechanics,
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				
	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, Stud	y Time in Lecture 42		
Credit points	4			
Examination	Written exam			
Examination duration and scale	120 min, 10 problems with two pa	arts a) and b) plus physics lab attestation	า	
		lish program): Core qualification: Compo lish program, 7 semester): Core qualific		sory

Course L0557: Physics for Engineers (GES)		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Alexander Petrov	
Language	EN	
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>D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics - Extended Edition, 7 <sup>th</sup> ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornton and Physics by Tipler and Mosca.</li> </ul>	

Course L0560: Physics for Engineers (GES)	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Alexander Petrov
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

#### Module M0577: Nontechnical Complementary Courses for Bachelors

Module Responsible Dagmar Richter	
Admission Requirements	None
Recommended Previous Knowledge	None
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results

Competence

#### The Non-technical Academic Programms (NTA)

imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.

#### The Learning Architecture

consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree 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 be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in 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 across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in 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's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.

The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in 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's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.

This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working

#### Specialized Competence (Knowledge)

Students can

- locate selected specialized areas with the relevant non-technical mother discipline.
- outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,
- · different specialist disciplines relate to their own discipline and differentiate it as well as make
- 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 sociocultural interpretation and historicity,
- Can communicate in a foreign language in a manner appropriate to the subject.

#### **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)
	Students will be able
Social Competence	<ul> <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

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

Module M0745: E	lectrical Engineering I			
Courses				
Title Electrical Engineering I (L06 Electrical Engineering I (L06		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 5 1
Module Responsible	Prof. Manfred Kasper			
Admission Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>and magnetic fields. This includes especially:</li> <li>Kirchhoff's voltage and current laws,</li> <li>Ohm's law,</li> <li>methods to simplify and analyze direct current networks,</li> <li>description of electric and magnetic fields by use of vectorial field quantities,</li> <li>Basic material relations,</li> <li>Gauss's law,</li> <li>Ampère's law,</li> <li>induction law,</li> <li>Maxwell's equation in the integral form,</li> <li>concept and definition of resistance, capacitance and inductance.</li> </ul> The students are able to establish relations between currents and voltages in simple direct current networks and to apply these to calculate and dimension networks. Student know to apply the			
Skills	fundamental laws of electric and magnet field quantities. Students know to calcula arrangements.			
Personal Competence				
Social Competence	Students are able to solve specific proble Students can explain concepts and on the			
Autonomy	Students are able to acquire particular knowledge using textbook in a self-learning process, to integrate, present and associate this knowledge with other fields. The students develop perseverance to also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points				
	Written exam			
Examination duration and scale				
	General Engineering Science (English pro General Engineering Science (English pro			sory

Course L0677: Electrica	al Engineering I
Тур	Lecture
Hrs/wk	3
СР	5
<b>Workload in Hours</b>	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Manfred Kasper
Language	EN
Cycle	WiSe
Content	<ol> <li>Basics of Resistive Circuits</li> <li>Simplifying Resistive Circuits</li> <li>Network Analysis</li> <li>The Electrostatic Field</li> <li>Stationary Currents in Conductive Media</li> <li>Electrostatic Field in Non-Conductive Media</li> <li>Static Magnetic Field</li> <li>Induction and Time-Dependent Fields</li> </ol>
Literature	<ol> <li>M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013</li> <li>A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008</li> <li>P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996</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> </ol>

Course L0679: Electrica	ourse L0679: Electrical Engineering I	
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	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0671: T	echnical Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics		Lecture	2	4
Technical Thermodynamics Technical Thermodynamics		Recitation Section (large) Recitation Section (small)	1 1	1
Module Responsible	· · · ·	Recitation Section (smail)		1
Admission				
Requirements Recommended				
Previous Knowledge	Elementary knowledge in Mathematics and Mecha	anics		
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence	Students are familiar with the laws of Thermodyr	namics. They know the rate	tion of the !	kinds of anarcy
Knowledge	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 of 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 states are able to calculate state variables for an ide variables.	and to use this calculation	s for the Car	not cycle. They
Personal Competence				
	The students are able to discuss in small groups a	and develop an approach.		j
Autonomy	Students are able to define independently tasks, t as to find ways to use the knowledge in practice.	to get new knowledge from	existing kno	owledge as well
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): General Engineering Science (German program, 7 Bioprocess Engineering: Core qualification: Compi Energy and Environmental Engineering: Core qua General Engineering Science (English program): C General Engineering Science (English program, 7 Computational Science and Engineering: Specialis Mechanical Engineering: Core qualification: Comp Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsor Technomathematics: Specialisation III. Engineerin Process Engineering: Core qualification: Compulsor	semester): Core qualificatulsory lification: Compulsory Core qualification: Compulsors semester): Core qualification sation Engineering Sciences ulsory  y g Science: Elective Compu	ory on: Compuls on: Compuls on: Elective Co	ory

Course L0437: Technica	al 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         <ul> <li>3.1 Thermal equation of state</li> </ul> </li> <li>First law         <ul> <li>4.1 Heat and work</li> <li>4.2 First law for closed systems</li> <li>4.3 First law for open systems</li> <li>4.4 Examples</li> </ul> </li> <li>Equations of state and changes of state         <ul> <li>5.1 Changes of state</li> <li>5.2 Cycle processes</li> </ul> </li> <li>Second law         <ul> <li>6.1 Carnot process</li> <li>6.2 Entropy</li> <li>6.3 Examples</li> <li>6.4 Exergy</li> </ul> </li> <li>Thermodynamic properties of pure fluids         <ul> <li>7.1 Fundamental equations of Thermodynamics</li> <li>7.2 Thermodynamic potentials</li> <li>7.3 Calorific state variables for arbritary fluids</li> <li>7.4 state equations (van der Waals u.a.)</li> </ul> </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: Technica	ourse 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	
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	

Module M0772: E	lectrical Engineering II			
Courses				
Title Electrical Engineering II (LO' Electrical Engineering II (LO'		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 5 1
Module Responsible	Dr. Helge Fielitz			
Admission Requirements	None			
Recommended Previous Knowledge	It ontent of the Lecture "Flectrical Engineering	g I (Elektrotechnik I)"		
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students know the basic theory, relations and methods of time dependent network theory and basic nonlinear circuit elements. This includes, in particular:  • transients, • the use of complex numbers and phasors, • the concept of impedance, • steady state sinusoidal circuit analysis, • complex power and 3-phase systems, • transformers, • transfer function and filters, • the concept of resonance, • diodes and rectifiers, • bipolar transistors and operational amplifiers			
Skills	The students are able to establish relations networks. The students know how to apply filter-like structures, and resonating networ elements, such as diodes, bipolar transistors	network theory to analyze 3-ph	ase system ude basic r	s, transformers, ionlinear circuit
Personal Competence				
Social Competence	Students are able to solve specific probl			
Autonomy	Students are able to acquire particular knowledge using textbooks in a self-learning process, to integrate, present, and associate this knowledge with other fields. The students develop persistency to also solve more complicated problems.			
	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
	Written exam			
Examination duration and scale				
	General Engineering Science (English progra General Engineering Science (English progra			sory

Course L0747: Electrica	al Engineering II
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Helge Fielitz
Language	EN
Cycle	SoSe
Content	<ul> <li>Transients</li> <li>Periodic and sinusoidal signals</li> <li>Power in AC circuits</li> <li>Three-phase systems</li> <li>Transformers</li> <li>Harmonic analysis, transfer functions, filters, locus curve, and Bode plot</li> <li>Resonant circuits</li> <li>Diodes and nonlinear circuits</li> <li>Bipolar transistor and operational amplifier</li> </ul>
Literature	<ul> <li>A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)</li> <li>M. Albach: "Elektrotechnik", (Pearson, 2011).</li> </ul>

Course L0748: Electrica	ourse L0748: Electrical Engineering II	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Helge Fielitz	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

	4. 1. 1. (050)			
Module M1103: N	lechanics II (GES)			
Courses				
Title		Тур	Hrs/wk	СР
Mechanics II (GES) (L1417)		Lecture	2	3
Mechanics II (GES) (L1418)		Recitation Section (large)	2	3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission	None			
Requirements	1			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional				
Competence	I I			., .
	The primary purpose of the study of M predict the effects of forces on elastic bodie rest (in equilibrium). Such a capacity is critic The particular objectives of this course are to	es, structural elements and simples, structural elements and simples.	ole structure	es, which are at
Knowledge	<ol> <li>Introduce the student to the basic prielastic bodies, structural elements an</li> <li>Demonstrate sound techniques of coreal engineering systems;</li> <li>Promote the analytical and problem engineering problems effectively.</li> </ol>	d simple structures in equilibriur onstructing and solving idealise	n; d mathema	itical models of
	At the end of this course the student should  1. Determine average normal and shear  2. Determine shear stresses and the ang  3. Determine thermal stresses in rods.	stresses.	cular shaft.	
Skills	4. Analyse statically indeterminate rods	s well as principal axes and mom as well as deflections due to be ransformation). ple systems and buckling of elas	nding. itic columns	
Personal Competence				İ
Social Competence	Students can: -work in groups and report or			ixed teams and
Autonomy	Students are able to; - solve the problems strengths and weaknesses, e.g. with the help		of hints, - as	ssess their own
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
	1.5 hours Mechanics of Solids: stress ar transformation, moments of inertia, buckling		, torsion, l	bending, stress
	General Engineering Science (English progra General Engineering Science (English progra			sory

Course L1417: Mechani	ics II (GES)
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	SoSe
Content	<ol> <li>Normal and shear stress, average normal and shear stress.</li> <li>Normal and shear strain.</li> <li>Axial loading: elastic deformation and statically indeterminate problems. Thermal stresses. Statically indeterminate axially loaded rods.</li> <li>Area moments of inertia.</li> <li>Torsion of a circular shaft: shear strain and stress, the angle of twist.</li> <li>Bending. Pure and symmetric bending: normal strain and stress. Deflection of beams: elastic curve. Statically indeterminate beams.</li> <li>Un-symmetric bending.</li> <li>Bending with a transverse shear: shear stresses in beams. Shear flow in thin-walled members, shear center.</li> <li>Plane-stress transformation.</li> <li>Stability of equilibrium and buckling of elastic columns.</li> <li>Elastic strain energy and energy methods: Castigliano's theorem - determination of displacements and statically indeterminate problems.</li> <li>*Membrane theory of rotational shells: thin-walled pressure vessels.*</li> </ol>
Literature	<ol> <li>R.C. Hibbeler, Mechanics of Materials, Pearson, Prentice Hall, SI 2<sup>nd</sup> Edition</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI 3<sup>rd</sup> Edition</li> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4<sup>tl</sup> Edition</li> </ol>

Course L1418: Mechanics II (GES)		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Radoslaw Iwankiewicz	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0737: M	lathematical Analysis			
Courses				
<b>Title</b> Mathematical Analysis (L06 Mathematical Analysis (L06 Mathematical Analysis (L06	48)	Typ Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 4 2 2	<b>CP</b> 4 2 2
Module Responsible	•	Recitation Section (Smail)		
Admission Requirements				
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts appropriate examples.</li> <li>Students can discuss logical connection illustrating these connections with the help</li> <li>They know proof strategies and can reproduce</li> </ul>	ns between these concep p of examples.		
Skills	<ul> <li>Students can model problems in analysis Moreover, they are capable of solving ther</li> <li>Students are able to discover and verif studied in the course.</li> <li>For a given problem, the students can deverifically evaluate the results.</li> </ul>	m by applying established n fy further logical connection	nethods. ons betwee	n the concepts
Personal Competence				
Social Competence	- Students are able to work together (e.g. on the teams (i.e., teams from different study programmesults appropriately (e.g. during exercise class).	ns and background knowle	heterogened edge) and f	ously composed to present their
Autonomy	<ul> <li>Students are capable of checking their underspecify open questions precisely and know where</li> <li>Students can put their knowledge in relation to</li> <li>Students have developed sufficient persistence manner on hard problems.</li> </ul>	e to get help in solving then the contents of other lectur	res.	
	Independent Study Time 128, Study Time in Lect	ture 112		
Credit points				
	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Computer Science: Core qualification: Compulsor General Engineering Science (English program): General Engineering Science (English program, 7	Core qualification: Compuls		sory

Course L0647: Mathematical Analysis		
Тур	Lecture	
Hrs/wk	4	
СР	4	
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56	
Lecturer	Dr. Francisco Javier Hoecker-Escuti	
Language	EN	
Cycle	SoSe	
	Convergence, sequences, and series  Continuity  Elementary functions  Differential calculus  Integral calculus  Sequences of functions	
Literature	Königsberger: Analysis Forster: Analysis	

ourse L0648: Mathematical Analysis		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Course L0649: Mathematical Analysis		
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						
<b>Title</b> Fundamentals of Mechanica Fundamentals of Mechanica	_			<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Dr. Ar	thur Seibel				
Admission Requirements	None					
Recommended Previous Knowledge		Basic knowledge about mechanic Internship (Stage I Practical)	s and produ	uction engineering		
<b>Educational Objectives</b>	After	taking part successfully, students	have reach	ed the following learning	results	
Professional Competence						
Knowledge	After passing the module, students are able to:  • explain basic working principles and functions of machine elements,  • explain requirements, selection criteria, application scenarios and practical examples of bas machine elements, indicate the background of dimensioning calculations.					
Skills	•	passing the module, students are accomplish dimensioning calcula transfer knowledge learned in skills), recognize the content of technica technically evaluate basic design	tions of cov the module al drawings	to new requirements a	nd tasks (p	problem solvir
<b>Personal Competence</b>						
Social Competence	Stude	ents are able to discuss technical in	nformation i	n the lecture supported b	y activating	methods.
Autonomy		Students are able to independen Students are able to acquire add e.g. by using the video recording	itional know	ledge and to recapitulate		
Workload in Hours	Indep	endent Study Time 124, Study Tin	ne in Lectur	e 56		
Credit points	6					
Examination	Writte	en exam				
Examination duration and scale	120 n	nin				

	entals of Mechanical Engineering (GES)
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Arthur Seibel
Language	EN
Cycle	SoSe
Content	Introduction to design Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts  Presentation of technical objects (technical drawing)  Exercise  Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axis & shafts
Literature	

Course L1899: Fundamentals of Mechanical Engineering (GES)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Arthur Seibel	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0688: T	echnical Thermodynamics II			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics		Lecture	2	4
Technical Thermodynamics Technical Thermodynamics		Recitation Section (large) Recitation Section (small)	1 1	1 1
-	· · · · ·	Recitation Section (Small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics, M	Mechanics and Technical Thermodyr	namics I	
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	Students are familiar with different cy Clausius-Rankine. They are able to deriv different factors. They know the differer cycle, cooling cycle). They have increase cycles in Thermodynamics related diagra air processes and are able to perform sknowledge in gas dynamics and know the nozzle.	e energetic and exergetic efficience nce between anti clockwise and clo d knowledge of steam cycles and a ams. They know the laws of gas mi simple combustion calculations. Th	ies and knot ockwise cyc re able to dr extures, esp ey are prov	ow the influence cles (heat-power raw the different ecially of humid vided with basic
Skills	Students are able to use thermodynamic able to formulate energy, exergy- and e They are able to perform simple safety are able to transform a verbal formulated	entropy balances and by this to op calculations in regard to an outflow	timise tech ving gas fro	nical processes.
Personal Competence				
Social Competence	The students are able to discuss in small	groups and develop an approach.		
	Students are able to define independentl as to find ways to use the knowledge in p	,	existing kn	owledge as well
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula				

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	8. Cycle processes 7. Gas - vapor - mixtures 10. Open sytems with constant flow rates 11. Combustion processes 12. Special fields of Thermodynamics	
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: Technica	ourse 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 M1105: M	Mechanics III (GES)				
Courses					
Title		Тур	Hrs/wk	СР	
Mechanics III (GES) (L1421) Mechanics III (GES) (L1420)		Lecture Recitation Section (small)	3	3 2	
Mechanics III (GES) (L1419)		Recitation Section (Iarge)	1	1	
Module Responsible Prof. Radoslaw Iwankiewicz					
Admission Requirements					
Recommended	None				
Previous Knowledge	   After taking part successfully, students have reach	ed the following learning	results		
Professional		ed the following fediting f	CSUICS		
Competence	<u> </u>				
	The primary purpose of the study of Mechanics III the capacity to predict the effects of forces and moving machine parts, different machinery, vehicletc. The particular objectives of this course are to:	motions, necessary for	the analysis	and design of	
Knowledge	<ol> <li>Determine the hydrostatic forces acting on different objects.</li> <li>Analyse stability of floating bodies.</li> <li>Analyse the kinematics and kinetics of a particle in different reference systems,</li> <li>Analyse the motion of the system of particles and forces acting on it,</li> <li>Analyse the plane motion of a rigid body (simple mechanism) and forces acting on it.</li> <li>Analyse the three-dimensional motion of a rigid body and forces acting on it.</li> </ol>				
	At the end of this course the student should be ab	le to:			
	<ol> <li>Solve the equilibrium problems with account</li> <li>Analyse stability of simple floating bodies.</li> </ol>	t for hydrostatic pressure	forces.		
	3. Calculate the velocity and acceleration of a part	icle in different reference	systems.		
	4. Derive and solve the equation of motion of	of a particle in different re	erence syst	ems.	
	5. Analyse the motion of the system of particles as impulse-momentum relationships,	nd forces acting on it with	the aid of w	ork-energy and	
Skills	6. Calculate the instantaneous linear and ar mechanisms.	ngular velocities and ac	celerations	of the planar	
	7. Derive and solve the equations of a plane motion	n of a rigid body and find	forces actin	g on it,	
	8. Apply work-energy and impulse-momentum rela	tionships to analyse plane	kinetics of	a rigid body.	
	9. Calculate the instantaneous linear and an dimensional motion of a rigid body.	gular velocities and acc	elerations (	of the three-	
	10. Derive the equations of a motion of a three-dir	mensional motion of a rig	id body.		
	11. Apply in three-dimensional kinematics and kinem	netics of rigid body both	methods of	vector algebra	
Personal Competence					
Social Competence	present them to others, - assess the team collabor	ation and their share in it.			
Autonomy	Students are able to: -solve the problems indeposite strengths and weaknesses, e.g. with the aid of the		t hints, - as	sess their own	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84			
Credit points					
	Written exam 2 hours Fluid Statics: hydrostatic pressure, buc	oyancy, stability of floati	ng vessels.	Kinematics of	
Examination duration and scale	particle of plane and 3D rigid had v Kinetics of				
Assignment for the Following Curricula		emester): Core qualification	on: Compuls		

Course L1421: Mechani	ourse L1421: Mechanics III (GES)		
Тур	Lecture		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Radoslaw Iwankiewicz		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1420: Mechani	ourse L1420: Mechanics III (GES)		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Radoslaw Iwankiewicz		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Community of the standard of t				
Course L1419: Mechanics III (GES)				
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Radoslaw Iwankiewicz			
Language	EN			
Cycle	WiSe			
Content	<ol> <li>FLUID STATICS         <ol> <li>Fluid pressure, hydrostatic pressure on flat and cylindrical surfaces.</li> <li>Buoyancy force, buoyancy center, metacenter, stability of floating objects.</li> </ol> </li> <li>KINEMATICS         <ol> <li>Kinematics of a particle. Plane curvilinear motion: rectangular coordinates, normal and tangential coordinates, polar coordinates. Space curvilinear motion.</li> <li>Constrained motion of connected particles.</li> <li>Plane kinematics of a rigid body.</li> <li>Relative (compound) motion.</li> <li>Three-dimensional kinematics of a rigid body.</li> </ol> </li> <li>KINETICS         <ol> <li>Kinetics of a particle and of a system of particles.</li> <li>Plane kinetics of a rigid body.</li> <li>Three-dimensional kinetics of a rigid body.</li> </ol> </li> </ol>			
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley &amp; Sons, SI Version, 4<sup>th</sup> Edition</li> <li>R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3 <sup>rd</sup> Edition</li> </ol>			

Module M0853: M	lathematics III			
Courses				
Title Analysis III (L1028) Analysis III (L1029)		Typ Lecture Recitation Section (small)	Hrs/wk 2 1	<b>CP</b> 2 1
Differential Equations 1 (Or	dinary Differential Equations) (L1031) dinary Differential Equations) (L1032) dinary Differential Equations) (L1033)	Recitation Section (large) Lecture Recitation Section (small) Recitation Section (large)	1 2 1 1	1 2 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I + II			
<b>Educational Objectives</b>	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	Students are able to work together in language.	-		
Social Competence	<ul> <li>In doing so, they can communicate r partners. Moreover, they can design 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				
	Written exam			
Examination duration and scale	Thu min (Analysis III) + bu min (Differential Fo	quations 1)		
Assignment for the Following Curricula				

Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

Course L1028: Analysis	i III
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis	Course 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: Differential Equations 1 (Ordinary Differential Equations)		
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 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	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1032: Differential Equations 1 (Ordinary 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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1033: Differential Equations 1 (Ordinary 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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1273: A	dvanced Internship AIW/ GES	
Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Prof. Robert Seifried	
Admission Requirements	None	
Recommended Previous Knowledge	150 Creditpoints in General Engineering Science	
<b>Educational Objectives</b>	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	
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Engineering Science: 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: P	rinciples of Building Materia	als and Building 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 Materi		Lecture	2	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of physics, chemistry and ma	thematics from school		
<b>Educational Objectives</b>	After taking part successfully, students h	nave reached 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 learn the very extensive specialist knowledge.			
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 h written exam			
	General Engineering Science (German p Compulsory General Engineering Science (German Compulsory Civil- and Environmental Engineering: Cc General Engineering Science (English p Compulsory General Engineering Science (English Compulsory Technomathematics: Specialisation III. En	n program, 7 semester): Specia ore qualification: Compulsory orogram): Specialisation Civil- and n program, 7 semester): Specia	lisation Civ	vil Engineering

Course L0217: Building	Physics
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	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
	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

Course L0219: Building	urse L0219: Building Physics		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	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 Physics		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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: Principles 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: S	tructural Analysis I			
Courses				
Title Structural Analysis I (L0666) Structural Analysis I (L0667)		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible		, , ,		
Admission Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	After successfully completing this module, analysis of statically determinate systems.	students can express the bas	ic aspects	of linear frame
Skills	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				
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 homew enabled to self-assess their learning progress			dback, they are
Workload in Hours	Independent Study Time 124, Study Time in I	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 Minuren			
	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 Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Course L0666: Structur	al Analysis I
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	WiSe
Content	Statically determinate structural systems  basics: statically determinacy, equilibrium, method of sections forces: determination of support reactions and internal forces influence lines of forces displacements: calculation of discrete displacements and rotations, calculation of deflection curves principle of virtual displacements and virtual forces work-engergy theorem differential equation of beam
	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

Course L0667: Structur	Course 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		

Module M0590: B	Building Materials and Buildi	ing Chemistry		
Courses				
Title		Тур	Hrs/wk	СР
Building Materials and Build		Lecture	4 1	4 2
Building Materials and Build		Recitation Section (small)	1	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements	INONE			
Recommended Previous Knowledge		nd Building Physics		
<b>Educational Objectives</b>	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain the most important components, the manufacture, the structure, the most important characteristics of the mechanical behaviour and the corrosion behaviour, the material 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 to 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 eacl learning groups and to carry out exercise		ve specialist	knowledge in
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
Workload in Hours	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	17 n written exam			
Assignment for the Following Curricula		ore qualification: Compulsory		

Course L0248: Building	Materials and Building Chemistry
Тур	Lecture
Hrs/wk	4
СР	4
<b>Workload in Hours</b>	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

Course L0249: Building	urse L0249: Building Materials and Building Chemistry		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Frank Schmidt-Döhl, Rene Sanmann		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0706: G	ieotechnics I			
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			
D	Modules :			
Recommended Previous Knowledge	Mechanics I-II			
<b>Educational Objectives</b>	After taking part successfully, students have r	reached the following learning	results	
Professional Competence				
Knowledge	The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, water or structures, consolidation and settlement calculations, as well as 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 Le	cture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory Civil- and Environmental Engineering: Core qu. General Engineering Science (English progr. Compulsory General Engineering Science (English progr. Compulsory Technomathematics: Specialisation III. Engineering	ogram, 7 semester): Special lalification: Compulsory am): Specialisation Civil- and ogram, 7 semester): Specia	ilisation Civ	vil Engineering:

Course L0550: Soil Mechanics		
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	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 Med	urse L1493: Soil Mechanics		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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: R	leinforced Concrete I			
Courses				
Title		Тур	Hrs/wk	СР
Project Seminar Concrete I (		Seminar	1	1
Reinforced Concrete Design		Lecture	2	3
Reinforced Concrete Design	. (L0305)	Recitation Section (large)	2	2
	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous Knowledge		ding materials.		
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional				
Competence	! !			
Knowledge	The students can outline the history of concengineering, including usual load combination dimension simple structures, as well as to evaluate the structural members.	ons and safety concepts. Th	ney are abl	e to draft and
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 critically reflect the results.	s in the conception and dimen	sioning of st	ructures and to
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination				
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German pro- Compulsory Civil- and Environmental Engineering: Core qua General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory	gram, 7 semester): Specia alification: Compulsory n): Specialisation Civil- and	lisation Civ	il Engineering:

Course L0896: Project	Course L0896: Project Seminar Concrete I	
Тур	Seminar	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach, Björn Schütte	
Language	DE	
Cycle	SoSe	
Content	In the course of the project seminar, a simple structure is drafted and dimensioned.	
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!	

Course L0303: Reinforced Concrete Design I	
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	SoSe
Content	<ul> <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: Reinford	ourse 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	

Module M0744: S	itructural Analysis II			
	•			
Courses				
Title	Тур		Hrs/wk	СР
Structural Analysis II (L0673 Structural Analysis II (L0674		ure tation Section (large)	2	3
	1	tation section (large)		
Module Responsible Admission				
Requirements				
Recommended Previous Knowledge	Ctructural Analysis I			
<b>Educational Objectives</b>	After taking part successfully, students have reached th	ne following learning r	esults	
Professional Competence				
Competence	After successful completion of this module, students analysis of statically indeterminate systems.	can express the bas	ic aspects o	of linear frame
Knowledge				
Skills	After successful completion of this module, the studer construct influence lines of statically inderminate plane			
Personal Competence				
Social Competence	participate in subject-specific and interdisciplinary     defend their own work results in front of others     promote the scientific development of colleagues     Furthermore, they can give and accept profession	5	sm	
Autonomy	The students are able to work in-term homework assig enabled to self-assess their learning progress during the	•		back, they are
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 Minuten			
Assignment for the Following Curricula		semester): Speciali n: Compulsory ialisation Civil- and E	isation Civi Enviromenta	I Engineering:

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>
	Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 - Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004

Course L0674: Structur	ourse L0674: Structural Analysis II	
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0611: S	iteel Structures I			
Courses				
Title Steel Structures I (L0299) Steel Structures I (L0300)	ı	<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	INONE			
Recommended Previous Knowledge	,	Physics		
<b>Educational Objectives</b>	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Knowledge	After passing this module students are able to  • give a summary of the security concept • explain the priciples of the design process • describe and illustrate the bhaviour of memers in tension, compression and bending			
Skills	Students can rate and apply the material steel appropriately can use the security concept with respect to look the compression and bending.	pads, forces and resistan	ces.	J
Personal Competence				
	After participation of an optional course (buildin themselves in groups. They will be successful in according to design drawings.		•	•
Autonomy				
-	Independent Study Time 124, Study Time in Lecture	e 56		
Credit points				
	Written exam			l
Examination duration and scale	1120 minutes			
Assignment for the Following Curricula	If ivil_ and Environmental Engineering ( ore gualitica	ition: Compulsory		3 3

Course L0299: Steel Structures 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

Course L0300: Steel Structures I	
Тур	Recitation Section (large)
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	See interlocking course
Literature	See interlocking course

Module M0728: H	ydraulic Engineering I			
Courses				
<b>Title</b> Hydrology (L0909)		<b>Typ</b> Lecture	Hrs/wk	<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  Mechanics I und II			
Educational Objectives		ned the following learning	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 hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of 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 practice problems. Furthermore, they are able to run, explain and document basic hydraulic experiments. 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 unit-hydrograph to given problems.  In addition, the basic concepts of field - measurements of hydrological and hydrodynamic values can be			
	described and the students are able to perform, a	nalyze and assess respect	ive measure	ments.
Personal Competence	The students are able to work in groups in a goal-	orientated structured mai	nner They c	an evnlain thei
Social Competence	results by use of peer learning approaches. For technical presentations for given topics in groups.	urthermore, they are abl		
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6		-	
Examination	Written exam			
	The duration of the examination is 2 hours. The e understanding of the lecture contents and calcula		with respec	t to the genera
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qualific General Engineering Science (English program Compulsory	cation: Compulsory		-

Course L0909: Hydrology	
Тур	Lecture
Hrs/wk	1
СР	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:  • 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 L0956: Hydrology	
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: Hydromechanics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Characteristics of fluids</li> <li>Hydrostatics</li> <li>Kinematics of flows, laminar and turbulent flows</li> <li>Conservation laws         <ul> <li>Conservation of mass</li> <li>Conservation of Energy</li> <li>Momentum Equation</li> </ul> </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: Hydromechanics	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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

Module M0626: V	Vater Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (L0		Lecture	1	1
Groundwater Hydrology (L0		Recitation Section (large)	1	2
Water Management and Wa	ater Quality (L0366)	Lecture	2	3
Module Responsible	NN			
Admission Requirements	INONA			
Recommended Previous Knowledge		g I, Chemistry		
<b>Educational Objectives</b>	After taking part successfully, studen	ts have reached the following learning	results	
Professional Competence				
Knowledge	Students are able to define terms of the hydrologic cycle and also parameters to identify the water quality. Typical aquifer types and the occuring flow and storage processes can be explained technically. They are able to derive the Darcy law and the mathematical description of flow processes as well as their solution. They are in a position to explain the physical background of well hydraulic. 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 hydrological water balances. They are able to construct ground water contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraulic conductivities and storage coefficients.			
Personal Competence				
Social Competence	Students are able to help each other	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	1 1 20 min			
Assignment for the Following Curricula				

Course L0251: Ground	water Hydrology
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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: Groundy	ourse L0252: Groundwater Hydrology	
Тур	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	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview:  • Water balance, water availability , water scarcity, water recycling • Water quality parameter (organic, inorganic), assessment and decision support tools.	
Literature	Teil Wasserwirtschaft:  • Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001  • Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011  • Pdf der Vorlesung	

Courses				
<b>Title</b> Introduction to Control Syst	ems (I 0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements	   Representation of signals and system	ns in time and frequency domain, Lapla	ce transform	<u> </u>
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, stude	nts 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 term 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 and 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 and frequence response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time arruse 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 the		ly validate the	
	controller designs   Students can obtain information     experiment guides) and use it when	from provided sources (lecture notes solving given problems.	s, software	documentatio
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Examination Examination	Written exam			
and scale				
		rman program, 7 semester): Special	isation Com	nputer Science
	Compulsory General Engineering Science (Germ	nan program, 7 semester): Specialisati	on Bioproce	ss Engineerin
	Compulsory			
	Compulsory	rman program, 7 semester): Special	ısatıon Nava	ai Aichitectur
		rman program, 7 semester): Specia	alisation Civ	il Engineering
	Compulsory General Engineering Science (Gerr	man program, 7 semester): Specialisa	tion Electric	al Engineerin
	Compulsory General Engineering Science (Germ	nan program, 7 semester): Specialisati	on Riomedic	al Engineerin
	Compulsory			5
	General Engineering Science (Germ Engineering: Compulsory	an program, 7 semester): Specialisation	n Energy ar	nd Enviroment
	General Engineering Science (Ger	man program, 7 semester): Specialis	ation Proce	ss Engineerin
	Compulsory General Engineering Science (Germ	nan program, 7 semester): Specialisati	on Mechanic	cal Engineering
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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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
avT	Lecture
Hrs/wk	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M0631: C	oncrete Structures II			
Courses				
Title Project Concrete Structures II (L0894) Concrete Structures II (L0348) Concrete Structures II (L0349)		<b>Typ</b> Project Seminar Lecture Recitation Section (large)	Hrs/wk 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 comb</li> <li>Basics of safety format are required.</li> <li>Knowledge in design of beams and columns</li> <li>Lecture 'Concrete Structures I'</li> </ul>			
Educational Objectives	After taking part successfully, students have reach	ned 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 desigr results at the end.	n in a team a real concre	te building a	and present the
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula				

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

Course L0348: Concrete 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>Design of discontinuity regions (e.g. corbels, frame corner)</li> <li>design of footings</li> <li>Introduction in the design of plates</li> <li>Layout and content of a structural design</li> </ul>	
Literature	<ul> <li>Vorlesungsumdrucke zum downloaden im STUDiP</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010</li> <li>König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998</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>	

ourse 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	

Module M0730: C				
Courses				
<b>Title</b> Computer Engineering (L03: Computer Engineering (L03:		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3	<b>CP</b> 4 2
	•	Recitation Section (Smail)	1	2
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Basic knowledge in electrical engineering			
<b>Educational Objectives</b>	After taking part successfully, students have reach	hed the following learning	results	
Professional Competence				
Knowledge	This module deals with the foundations of the fur from the assembly-level programming down to ga  Introduction Combinational logic: Gates, Boolean combinational networks Sequential logic: Flip-flops, automata, syste Technological foundations Computer arithmetic: Integer addition, subt Basics of computer architecture: Programm Memories: Memory hierarchies, SRAM, DRA Input/output: I/O from the perspective of connections, busses  The students perceive computer systems from	algebra, Boolean function ematic hardware design traction, multiplication and hing models, MIPS single-cy M, caches the CPU, principles of p	he following ons, hardw division rcle architec assing data	topics:  are synthesis  ture, pipelining , point-to-poir
Skills	internal structure and the physical composition of highly specific and individual computers can be components. They are able to distinguish betwee today's computing systems - from gates and circular 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 gain impact that these low abstraction levels have feasible options.	of computer systems. The be built based on a coll ten and to explain the difficits up to complete process a students are able to jude software executed on it of software has on the hates. This way, they will be	students ca ection of for erent abstrators. dge the inter- t. In particular ardware-cer e enabled to	in analyze, ho ew and simple action layers of erdependencie ular, they sha atric abstraction to evaluate th
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to prese	nt the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	m specific literature and to	o associate	this knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
	General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Biomechanics: Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation	on Bioproce sation Nava lisation Civicion Electricon Biomedicon Energy and ation Processon Mechanicon Mechanicon Nava Nava Nava Nava Nava Nava Nava Nav	ess Engineering al Architecture il Engineering al Engineering cal Engineering d Enviromenta ss Engineering cal 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
	Flactuical Fusing and and Construction Communication
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 (Énglish 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	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		
<b>Workload in Hours</b>	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 M0755: G	eotechnics II			
Courses				
Title		Тур	Hrs/wk	СР
Foundation Engineering (L0	552)	Lecture	2	2
Foundation Engineering (L0	•	Recitation Section (large)	2	2
Foundation Engineering (L1	494)	Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Modules:  • Mechanics I-II • Geotechnics I			
<b>Educational Objectives</b>	After taking part successfully, students l	have reached the following learning	results	
Professional Competence				
Knowledge	The students know the basic principles and methods which are required to verificate the stability of geotechnical structures.			
	After successful completion of the module the students are able to:			
Skills	<ul> <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	e in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	General Engineering Science (German p Compulsory Civil- and Environmental Engineering: Co General Engineering Science (English p Compulsory Technomathematics: Specialisation III. E	ore qualification: Compulsory program, 7 semester): Specialisation	ı Civil Engin	-

Course L0552: Foundat	ion Engineering
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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: Foundat	ourse L0553: Foundation Engineering		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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: Foundat	ourse 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				
Courses				
Title		Тур	Hrs/wk	СР
Applied Structural Dynamics		Lecture	2	2
Building Information Modelii	ng (L1903)	Lecture	1	1
Building Information Modeli	ng (L1904)	Project-/problem-based Learning	2	2
Computational Analysis of S		Lecture	2	3
Introduction in Statitics with	, ,	Lecture	1	1
Introduction in Statitics with	, ,	Recitation Section (large)	1	1
Principles of Geomatics (L04	•	Lecture	2	2
Principles of Geomatics (L04		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 Preventi	· · ·	Lecture	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Inone			
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge				
	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		able to perform tacks or to see	anduct a pro	iact in taams. If
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.			
	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			

Course L0791: Applied S	Structural Dynamics
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
and scale	15 min
	Dr. Kira Holtzendorff
Language	
Cycle	
	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
Content	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
	Helmut Kramer: Angewandte Baudynamik, Ernst & Sohn Verlag, 2. Auflage 2013
Literature	Christian Petersen: Dynamik der Baukonstruktionen, Vieweg Verlag, 2. Auflage von 2000

Hrs/wk 1  CP 1  Workload in Hours Independent Study Time 16, Study Time in Lecture 14  Examination Form Schriftliche Ausarbeitung  Examination duration and scale  Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer  Language DE  Cycle WiSe/SoSe  Basic knowledge of Building Information Modeling:  • Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  • Current standards and guidelines (national and international standardisation, structures)  • Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  • Object oriented modelling (requirements, structure, classification, parts catalogues)  • BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  • BIM-Tools (software, hardware, application areas)  • Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  • Basic settings (project administration, building structures, fileset structures, layers)  • Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  • Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  • Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  • Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  • Walls and columns (height definitions, parameters, attributes, format properties)  • Slabs (height definitions, parameters, attributes, format properties)  • Stairs and ramps (Stair wizard, IFC-Ramp)  • Roof frame and roof covering (custom planes, parameters, attributes, format properties)  • Stairs and ramps (Stair wizard, IFC-Ramp)  • Roof frame and roof covering (custom planes, parameters, attributes, format properties)  • Stairs and ramps (Stair wizard, IFC-Ramp)  • Roof frame and roof covering (custom planes, parameters, attributes, format properties)  • Stairs and ramps (Stair wizard; values (allocations and modifications)  • Export and Import of IFC-Data (basics, floor allocation,		
Workload in Hours   Independent Study Time 16, Study Time in Lecture 14	<b>Typ</b> Lecture	
Workload in Hours   Independent Study Time 16, Study Time in Lecture 14	Hrs/wk 1	
Examination Form   Schriftliche Ausarbeitung   Siehe Modulhandbuch   Siehe Modulhandbuch   Siehe Modulhandbuch   Siehe Modulhandbuch   Drof. Frank Schmidt-Döhl, Thomas Kölzer   Language   DE   Cycle   WiSe/SoSe   Basic knowledge of Building Information Modeling:    Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)   Current standards and guidelines (national and international standardisation, structures)   Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)   Object oriented modeling (requirements, structure, classification, parts catalogues)   BIM-Implementation (structures, cycles, professions, job profiles, execution plan)   BIM-Tools (software, hardware, application areas)   Execution examples (national and international construction projects)   Basic knowledge for the use of the software Allplan 2018:    Basic settings (project administration, building structures, fileset structures, layers)   Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)   Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)   Dimensioning and text adding of designed elements and structural components   Generating of areas (hatchings, patterns, fills)   Construction fundamentals 3D (floor concept, floor manager, building structures)   Walls and columns (height definitions, parameters, attributes, format properties)   Use of libraries (u. a. furnitures, surroundings etc.)   Opening Elements and SmartParts (doors and windows)   Stairs and ramps (stair wizard, IFC-Ramp)   Roof frame and roof covering (custom planes, parameters, attributes, format properties)   Attributes and characteristic values (allocations and modifications)   Export and Import of IFC-Data (basics, floor allocation, fileset selection)   Generating of sections and views (architecturial sections and associative sections)	<b>CP</b> 1	
Examination duration and scale  Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer  Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling:  Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, patterns, fills) Construction fundamentals 3D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes, format properties) Slabs (height definitions, parameters, attributes, format properties) Use of libraries (u. a. furnitures, surroundings etc.) Opening Elements and SmartParts (doors and windows) Stairs and ramps (stair wizard, IFC-Ramp) Roof frame and roof covering (custom planes, parameters, attributes, format properties) Attributes and characteristic values (allocations and modifications) Export and Import of IFC-Data (basics, floor allocation, fileset selection) Generating of sections and views (architecturial sections and associative sections)	Workload in Hours Independent Study Time 16, Study Time in Lecture 14	
Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer  Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling:  Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  Current standards and guidelines (national and international standardisation, structures)  Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  Object oriented modelling (requirements, structure, classification, parts catalogues)  BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  BIM-Tools (software, hardware, application areas)  Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers)  Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  Dimensioning and text adding of designed elements and structural components  Generating of areas (hatchings, paterness, fills)  Construction fundamentals 3D (floor concept, floor manager, building structures)  Walls and columns (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Use of libraries (u. a. furnitures, surroundings etc.)  Opening Elements and SmartParts (doors and windows)  Stairs and ramps (stair wizard, IFC-Ramp)  Roof frame and roof covering (custom planes, parameters, attributes, format properties)  Attributes and characteristic values (allocations and modifications)  Export and Import of IFC-Data (basics, floor allocation, fileset selection)  Generating of sections and views (architecturial sections and associative sections)	Examination Form Schriftliche Ausarbeitung	
Language  Cycle  Wise/SoSe  Basic knowledge of Building Information Modeling:  Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  Current standards and guidelines (national and international standardisation, structures)  Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  Object oriented modeling (requirements, structure, classification, parts catalogues)  BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  BIM-Tools (software, hardware, application areas)  Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers)  Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  Dimensioning and text adding of designed elements and structural components  Generating of areas (hatchings, patterns, fills)  Construction fundamentals 3D (floor concept, floor manager, building structures)  Walls and columns (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Use of libraries (u. a. furnitures, surroundings etc.)  Opening Elements and SmartParts (doors and windows)  Stairs and ramps (stair wizard, IFC-Ramp)  Roof frame and roof covering (custom planes, parameters, attributes, format properties)  Attributes and characteristic values (allocations and modifications)  Export and Import of IFC-Data (basics, floor allocation, fileset selection)  Generating of sections and views (architecturial sections and associative sections)	I SIENE MOGIJINANGNICO	
Cycle WiSe/SoSe  Basic knowledge of Building Information Modeling:  Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  Current standards and guidelines (national and international standardisation, structures)  Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  Object oriented modeling (requirements, structure, classification, parts catalogues)  BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  BIM-Tools (software, hardware, application areas)  Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers)  Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  Dimensioning and text adding of designed elements and structural components  Generating of areas (hatchings, patterns, fills)  Construction fundamentals 3D (floor concept, floor manager, building structures)  Walls and columns (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Use of libraries (u. a. furnitures, surroundings etc.)  Opening Elements and SmartParts (doors and windows)  Stairs and ramps (stair wizard, IFC-Ramp)  Roof frame and roof covering (custom planes, parameters, attributes, format properties)  Attributes and characteristic values (allocations and modifications)  Export and Import of IFC-Data (basics, floor allocation, fileset selection)	Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer	
Basic knowledge of Building Information Modeling:  Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  Current standards and guidelines (national and international standardisation, structures)  Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  Object oriented modeling (requirements, structure, classification, parts catalogues)  BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  BIM-Tools (software, hardware, application areas)  Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers)  Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  Dimensioning and text adding of designed elements and structural components  Generating of areas (hatchings, patterns, fills)  Construction fundamentals 3D (floor concept, floor manager, building structures)  Walls and columns (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Use of libraries (u. a. furnitures, surroundings etc.)  Opening Elements and SmartParts (doors and windows)  Stairs and ramps (stair wizard, IFC-Ramp)  Roof frame and roof covering (custom planes, parameters, attributes, format properties)  Attributes and characteristic values (allocations and modifications)  Export and Import of IFC-Data (basics, floor allocation, fileset selection)  Generating of sections and views (architecturial sections and associative sections)	<b>Language</b> DE	
Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)  Current standards and guidelines (national and international standardisation, structures)  Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)  Object oriented modeling (requirements, structure, classification, parts catalogues)  BIM-Implementation (structures, cycles, professions, job profiles, execution plan)  BIM-Tools (software, hardware, application areas)  Execution examples (national and international construction projects)  Basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, fileset structures, layers)  Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)  Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)  Dimensioning and text adding of designed elements and structural components  Generating of areas (hatchings, patterns, fills)  Construction fundamentals 3D (floor concept, floor manager, building structures)  Walls and columns (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Slabs (height definitions, parameters, attributes, format properties)  Stairs and ramps (stair wizard, IFC-Ramp)  Roof frame and roof covering (custom planes, parameters, attributes, format properties)  Attributes and characteristic values (allocations and modifications)  Export and Import of IFC-Data (basics, floor allocation, fileset selection)  Generating of sections and views (architecturial sections and associative sections)	Cycle WiSe/SoSe	
Literature -	Introduction to BIM (development, backgrounds, history, concurrent standards and guidelines (national and international Applications of BIM (openBIM, closedBIM, littleBIM, data are Object oriented modeling (requirements, structure, classifur BIM-Implementation (structures, cycles, professions, job per BIM-Tools (software, hardware, application areas) Execution examples (national and international constructional basic knowledge for the use of the software Allplan 2018:  Basic settings (project administration, building structures, seconstruction fundamentals 2D (e. g. line, circle, spline, elemonts) Modifying of construction elements (e. g. copy, mirror, iemoling) Dimensioning and text adding of designed elements are Generating of areas (hatchings, patterns, fills) Construction fundamentals 3D (floor concept, floor mana) Walls and columns (height definitions, parameters, attributes) Slabs (height definitions, parameters, attributes, format pro) Use of libraries (u. a. furnitures, surroundings etc.) Opening Elements and SmartParts (doors and windows) Stairs and ramps (stair wizard, IFC-Ramp) Roof frame and roof covering (custom planes, parameter, attributes and characteristic values (allocations and mo) Export and Import of IFC-Data (basics, floor allocation, file Generating of sections and views (architecturial sections) Generating of printable drawings (layouts, scales, page sections)	conal standardisation, structures) and interchange formats) fication, parts catalogues) profiles, execution plan) an projects)  fileset structures, layers) lipse, parallel etc.) and structural components  ger, building structures) tes, format properties) perties)  s, attributes, format properties) difications) eset selection) and associative sections)

Course L1904: Building Information Modeling	
Тур	Project-/problem-based Learning
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	siehe Modulhandbuch
Lecturer	Prof. Frank Schmidt-Döhl, Thomas Kölzer
Language	DE
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0370: Computational Analysis of Structures			
Тур	Lecture		
Hrs/wk	2		
СР	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>		
<ul> <li>Vorlesungsunterlagen können im STUDiP heruntergeladen werden</li> <li>Tutorials von SOFiSTiK</li> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ern &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, Londo 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktue 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>			

Course L0286: Introduc	ction in Statitics with R
Тур	Lecture
Hrs/wk	1
СР	1
	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and scale	60 min
	Dr. Joachim Behrendt
Language	
Cycle	
	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, test-distributions (t-F-X²-distribution))
	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
	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/10.1007/978-3-540-77510-2
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran.r-project.org/doc/contrib/Short-refcard.pdf Grafiken und Statistik in R von Andreas Plank
	Nachschlage Skript mit Beispielen: http://www.geo.fu-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: 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: Principles of Geomatics			
Тур	<b>Typ</b> Lecture		
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	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur		
Lecturer	Prof. Peter Andree		
Language	DE		
Cycle	SoSe		
Content	Overview of geomatics in general     Units of measurements     Generating of topographical maps     Basic surveying instruments and handling     Geodetic surveying lines and verification of measurements     Methods of horizontal survey     Components of geodetic surveying instruments		
Literature	Andree, P.:  Grundlagen der Geomatik (Skript)  Resnik, B. / Bill, R.: vermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmannverlag  Witte, B. / Sparla, P.: Wermessungskunde 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	Typ Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
	Fachtheoretisch-fachpraktische Arbeit		
Examination duration and scale	5 Übungsaufgaben jeweils mit Testat 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):  1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004  2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007  3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de  4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005		

Course L1744: Practica	l Course in Drinking Water Chemistry
	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
<b>Examination Form</b>	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	6 Versuchsprotokolle
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	!Max.12 students! 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.  1. Day: Introduction, safety instructions 2. Day: Electrical conductivity, saturation with respect to calcite, hardness 3. Day: Organic carbon, iron, acid and base neutralization capacity 4. Day: Writing protocols of experiments and presentations 5. Day: Evaluation of the protocols and presentations, final discussion
Literature	Siehe Skript. See Script.

Course L1228: Projects II		
Тур	Project Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Referat	
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 Protection 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	Philipp Below	
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: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	-			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to  • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management  • explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects  • describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing  • explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance  • state basics from accounting and costing and selected controlling methods.			
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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
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 coheren report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
	Students are able to			
Autonomy		emselves		
Workload in House	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points		C 10		
•	Subject theoretical and practical work			
Examination duration and scale				
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management	
Тур	Lecture	
Hrs/wk	3	
СР	3	
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. 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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>	
	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003	
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.	
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.	
Literature	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.	
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.	
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.	
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.	

Module M0579: S	tructural Design		
Courses			
<b>Title</b> Basics of Structural Design Exercises in Structural Design		TypHrs/wkCFLecture21Recitation Section (large)11	•
Seminar in Structural Desig	n (L0209)	Project-/problem-based Learning 2 4	
Module Responsible	Prof. Frank Schmidt-Döhl	Learning	
Admission Requirements	None		
Recommended Previous Knowledge		terials and Building Physics"	
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning results	
Professional Competence			
Knowledge	After attending the course students are able  • to define the basics of building regulations law		
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			
Social Competence	After attending the course students are able  to work in a team and to persent the re  to use the feedback from other student  to give a feedback to other students in	ts to improve the own results	
Autonomy	and tests (STUD.IP)	ge with the help of weeekly presentations (lect	
Workload in Hours	Independent Study Time 110, Study Time in l	Lecture 70	
Credit points	6		
Examination	Subject theoretical and practical work		
Examination duration and scale	Written exam (construction application) and v	written theory exam	
Assignment for the Following Curricula	Compulsory Civil- and Environmental Engineering: Core qu	ogram, 7 semester): Specialisation Civil Er ualification: Compulsory ogram, 7 semester): Specialisation Civil Er	

urse L0205: Basics o	f Structural Design
Тур	Lecture
Hrs/wk	2
СР	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Thomas Kölzer
Language	DE
Cycle	SoSe
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	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  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  Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion: [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied: Werner, 2007  Neufert, Ernst (Kister, Johannes) Bauentwurfslehre: Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernend ISBN: 978-3-8348-0732-8 (GB.) Wiesbaden: Vieweg + Teubner, 2009

	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	Falk Wagemann
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 f control</li> <li>Assessing the building stabilty</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>
	Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung
Literature	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  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  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  Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure: mit Berechnungshinweisen und Beispielen; [auf CD-RC Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied: Werner, 2006
	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  Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß u Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.)

	1
	Project-/problem-based Learning
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Thomas Kölzer
Language	
Cycle	<u>SoSe</u>
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 law</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 control</li> <li>Assessing the building stabilty</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>
	Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung
Literature	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  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  Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion: [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wängeschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied: Werner, 2007
	Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-RC Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied : Werner, 2006
	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
	Neufert, Ernst (Kister, Johannes) Bauentwurfslehre: Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß u Ziel; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.)

Module M0686: S	anitary Engineering			
Courses				
Title Wastewater Disposal (L027) Wastewater Disposal (L027) Drinking Water Supply (L03) Drinking Water Supply (L03)	3) 06)	<b>Typ</b> Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	CP 2 1 1 2
Module Responsible	Prof. Ralf Otterpohl	-		
Admission Requirements	·			
Recommended Previous Knowledge	<ul> <li>Basic knowledge on Chemistry a</li> <li>Hydraulics of pipe systems and o</li> <li>Basic knowledge on water mana</li> <li>Basic knowledge on Environmen</li> </ul>	open channels gement: water quantity and water qu	ality	
	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems in Germany and they are capable of reproducing the relevant empiricals assumptions and scientific simplifications. The students are able to present and discuss sanitary engineering processes and the technologies used for drinking and wastewater treatment. They			
Skills	The students are able to apply the rel urban water infrastructures independe water supply and urban drainage syst acquirement of technical skills the stud filed of drinking water and wastewater own to improve the existing water relat	ently. Their expertise comprises expe ems as well as the associated treat lents are able to address and solve be treatment. The students are also ab	ert skills to ment facilit piochemical ple to develo	design drinking ies. Besides the problems in the
Personal Competence  Social Competence	Social skills are not targeted in this more	dule.		
Autonomy	Students are able to form concepts of Therefore they can acquire appropriating regard to the approach to problems (pr	e knowledge when being given som	e clues or i	
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German Compulsory Civil- and Environmental Engineering: C General Engineering Science (English Compulsory	Core qualification: Compulsory		J

Course L0276: Wastew	ourse L0276: Wastewater Disposal		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Ralf Otterpohl		
Language	DE		
Cycle	SoSe		
Content	This lecture focusses on urban drainage and wastewater treatment.  Urban Drainage  Design of urban drainage systems (combined and separate sewer systems) Special structures Rainwater management  Wastewater treatement Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)		
Literature	<ul> <li>Biological Treatment (aerobic, anaerobic, anoxic)</li> <li>Special Wastewater Treatment Processes (Ozonation, Adsorption)</li> <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.). München: 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). Günthert, F. Wolfgang: (3., völlig 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: Wastew	urse L0278: Wastewater Disposal	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	y Water Supply
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst
Language	DE
Cycle	SoSe
	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
Content	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.
	Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag.
	Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag
Literature	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	Course L0308: Drinking Water Supply	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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: H	lydraulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)	-0.	Recitation Section (large)	1	1
Hydraulic Engineering (L095) Hydraulic Engineering (L096)	•	Lecture Recitation Section (large)	2 1	2 2
Module Responsible	,	Recitation Section (large)		
Admission				
Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.			
Skills	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 apply established approaches of hydraulics and determine water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system. Furthermore, they are able to run, explain and document basic hydraulic experiments.			
Personal 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 in a goal-orientated, structured manner. They can explain their results by use of peer learning approaches.			
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems. Furthermore, they are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Examination	Written exam			
	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.			
Assignment for the Following Curricula	I Civil and Environmental Engineering: Core gualiti	ication: Compulsory		J

Course L0957: Hydrauli	ics
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	Flow of incompressible fluids in pipes and open channels  Hydraulics of pipes Punps in hydraulic systems Open channel flow Regulative construction in open channel flow Weirs Sliding panels Cross-section reduction by constructions
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: Hydraul	ourse L0958: Hydraulics	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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: Hydraulic Engineering		
Typ Lecture		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	Fundamentals of hydraulic engineering  Introduction and hydrological cycle River engineering  Regime theory of natural rivers Sediment transport Regulation of rivers Bank protection / protection of river bed Tidal rivers  Flood protection Dikes Flood contraol basins Hydraulic power Inland waterways engineering waterways Locks and ship lifts Fish passages Nature-oriented hydraulic engineering	
Litoraturo	Strobl, T. & Zunic, F: Wasserbau, Springer 2006  Patt, H. & Gonsowski, P: Wasserbau, Springer 2011	

Course L0960: Hydraulic Engineering		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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				
<b>Title</b> Introduction into Process En Fundamentals of material en	gineering/Bioprocess Engineering (L0829) ngineering (L0830)	<b>Typ</b> Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 1 2
<b>Module Responsible</b>				
Admission Requirements	None			
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following l	earning results	
Professional Competence	After passing this module the students have			
Knowledge	<ul> <li>give an overview of the most importa</li> <li>explain some working methods for dif</li> </ul>			ring,
Skills	After passing this module the students shou     Iist and outline the most important fie     name the most important working a engineering,     read and prepare an engineering draw     explain the most important technolog     scheme typical chemical and biotechr	elds of process engineer approaches or methods wing, lies for wastewater and	of the different fi	nt
Personal Competence	The students are able to			
Social Competence	work out results in groups and docum     provide appropriate feedback and har		wn performance cor	nstructively.
Autonomy	The students are able to estimate their progof knowledge in Process Engineering and Bio		mselves and to delil	perate their lac
Workload in Hours	Independent Study Time 34, Study Time in L	ecture 56		
Credit points	3			
Examination	Written exam			
<b>Examination duration</b>	90 min	·		

	General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
A !	Compulsory
Assignment for the	Bioprocess Engineering: Core qualification: Compulsory
Following Curricula	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
	Process Engineering: Core qualification: Compulsory

Course L0829: Introduction into Process Engineering/Bioprocess Engineering		
Typ 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	
	Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.	
Literature	s. StudIP	

Course L0830: Fundamentals of material engineering		
Typ Lecture		
	Hrs/wk 2	
СР		
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>	
<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: eine Einführu Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013.</li> <li>Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.</li> </ul>		

Module M0730: C	omputer Engineering			
Courses				
<b>Title</b> Computer Engineering (L03 Computer Engineering (L03		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements				
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	The successful completion of the labs will be examination according to the following rules:  1. Upon a passed module examination, the studue to the successful labs, such that trespectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3	udent is granted a bonus o he examination's marks	on the examinate are lifted by	ination's marks
	, , , , , , , , , , , , , , , , , , , ,			
	After taking part successfully, students have reach	ed the following learning r	esults	
Professional Competence				
Knowledge	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:  • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses			
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify internal structure and the physical composition of computer systems. The students can analyze, highly specific and individual computers can be built based on a collection of few and sim components. They are able to distinguish between and to explain the different abstraction layers 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 interdependent between a physical computer system and the software executed on it. In particular, they slunderstand 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 propressible options.		n analyze, how we and simple action layers of erdependencies lar, they shal tric abstraction o evaluate the	
Personal Competence				
Social Competence	Students are able to solve similar problems alone of	or in a group and to preser	nt the results	s accordingly.
Autonomy	Students are able to acquire new knowledge fron with other classes.	n specific literature and to	associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				-
	Written exam			
Examination duration and scale	190 minutes contents of course and lans			
	General Engineering Science (German program): C General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory	n, 7 semester): Specialis 7 semester): Specialisation n, 7 semester): Specialis m, 7 semester): Specialis 7 semester): Specialisat	sation Com on Bioproces sation Nava isation Civi ion Electrica	ss Engineering I Architecture I Engineering al Engineering

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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** 

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 Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

## [95]

Course L0321: Computer Engineering			
Тур	Typ 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	

Module M0937: P	Physical Chemistry			
Courses				
<b>Title</b> Physical Chemistry (L0833) Physical Chemistry (L0835)				
Module Responsible	Prof. Hans-Ulrich Moritz			
Admission Requirements	None			
Recommended Previous Knowledge		1.		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	-to repeat the basic concepts of physical chemistry			
Moweage	-to describe and summarize the underlying concepts of mass-, heat- and momentum transfer.  - to interpret phase diagrams and affiliate kinetic rate laws.	-to describe and summarize the underlying concepts of mass-, neat- and momentum transfer.		
	The students are able to			
Skille	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.  - assess new applications with respect to environmental sustainability.			
Skiiis	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and l calculations.	kinetic		
Personal Competence				
	The students are able to plan, prepare, conduct and document experiments according to sciential guidelines in small groups.	entific		
Social Competence	The students are able to reflect their subject-specific knowledge orally in a team and to discuss i fellow students and faculty.	it with		
Autonomy	Students are able to assess their knowldege continuously on their own by exemplified pro- Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.	actice.		
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
	Written exam			
Examination duration and scale				
Assignment for the	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: 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: Elective Compulsory			

Course L0833: Physical Chemistry		
Typ Lecture		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Volker Abetz	
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>	

Course LO	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. Volker Abetz
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
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 M0536: F	undamentals of Fluid Mechanic	cs		
110001				
Courses				
<b>Title</b> Fundamentals of Fluid Mechanics for Process	• •	<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	,	ferential equations		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
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 proces engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundar 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	i			
Social Competence	are capable to gather information fror information to the context of the lectue able to work together on subject relaresults effectively in English (e.g. during are able to work out solutions for exempresent the results.	re and Ited tasks in small groups. The Ig small group exercises)	ey are able	to present their
	The students are able to			
Autonomy	search further literature for each topic     work on their exercises by their own a			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German programel Engineering: Compulsory Bioprocess Engineering: Core qualification: Cenergy and Environmental Engineering: Core General Engineering Science (English programel Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (Engineering Science (Engilsh Engils Engils Engils Engils Engils Engils Engils Engils Eng	am): Specialisation Bioprocess am): Specialisation Energy and orgram, 7 semester): Specialisation am, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation ampulsory qualification: Compulsory m): Specialisation Bioprocess E	Engineering: d Enviromen sation Proce son Bioproce on Energy ar ngineering:	Compulsory tal Engineering: ss Engineering: ss Engineering: nd Enviromental Compulsory
	General Engineering Science (English program General Engineering Science (English program 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
Process Engineering: Core qualification: Compulsory

Course L0091: Fundam	Course L0091: Fundamentals 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: 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>	

Course L0092: Fluid Me	chanics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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>

Courses Title Biochemistry (L0351) Biochemistry (L0728)		Тур		
Title Biochemistry (L0351)		Тур		
Biochemistry (L0351)		. , , ,	Hrs/wk	СР
Biochemistry (L0728)		Lecture	2	2
		Project-/problem-based	1	1
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			
	After taking part successfully, students have	reached the following learning	results	
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
	At the end of this module the students can:			
	- explain the methods of biological and biomolecules	biochemical research to de	etermine the	properties of
	- name the basic components of a living orga	anism		
Knowledge	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
CI:II-				
Skills Personal Competence				
_	The students are able,			
	- to gather knowledge in groups of about 10	students		
Social Competence	- to introduce their own knowledge and to ar	gue their view in discussions in	teams	
	- to divide a complex task into subtasks, solv	re these and to present the com	nbined result	5
Autonomy	The students are able to present the results	of their subtasks in a written re	port	
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German progragemental Engineering Science (German programmental Engineering Science (German programmental Engineering: Core qualification: Compureral Engineering Science (English progragemental Engineering Science (English programmental Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Science (English Engineering Engineerin	ram, 7 semester): Specialisati Compulsory m): Specialisation Bioprocess E ram, 7 semester): Specialisati	on Bioproces ngineering: ( on Bioproces	ss Engineering: Compulsory

Course L0351: Biochemistry		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
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	

Course L0728: Biochem	istry	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
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	

Course L0881: Microbiology		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Christian Schäfers	
Language		
Cycle	SoSe	
Content	<ul> <li>1. The procaryotic cell</li> <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> <li>2. Metabolism</li> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> <li>3. Microorganisms in relation to the environment</li> <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>	
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.), ehemals "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>	

Course L0888: Microbio	logy
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Christian Schäfers
Language	
Cycle	
Content	<ul> <li>1. The procaryotic cell</li> <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> <li>2. Metabolism</li> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> <li>3. Microorganisms in relation to the environment</li> <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>
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.), ehemals "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>

Module M0544: P	hase Equilibria Thermodynamics	5		
Courses				
Title Phase Equilibria Thermodyr Phase Equilibria Thermodyr Phase Equilibria Thermodyr	amics (L0140)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	· · · · ·			
Admission				
Requirements				
Recommended Previous Knowledge		mics I and II		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of thermodescribe thermodynamic equilibria.</li> <li>They learn how state variables are influe quantitatively describe these properties.</li> <li>Moreover, the students learn how phase phenomena may occur if different pruthermore the fundamentals of reactio</li> <li>For different phase equilibria, several eshown and the necessary knowledge for</li> </ul>	enced by the mixing of compose e equilibria can be described phases (vapor, liquid, solid n equilibria are taught. examples relevant for differe	mathematid) coexist	earn concepts to cally and which in equilibrium f processes are
Skills	<ul> <li>Applying their knowledge, the student determination of the equilibrium state an</li> <li>The students know models which can be equilibrium state and they are able to so</li> <li>For specific applications, they are all properties of compounds as well as mode</li> <li>Beside pure compound properties the mixtures.</li> <li>The students know how to visualize phat the occurring phenomena.</li> <li>Based on their knowledge, the students the basis for many separation and reactions.</li> </ul>	nd know how to simplify these used to determine the proposed live the resulting mathematic ble to self-reliantly find not parameters in literature so students are capable of deserving the see equilibria graphically and are able to understand fund	e equations perties of the al relations. ecessary plurces. escribing the they know larger to the amental co	meaningfully. e system in the nysico-chemica e properties o now to interpre
Personal Competence				
Social Competence	The students are able to work in small group: them oraly to the tutors and other students	s, to solve the correspondin	g problems	and to presen
Autonomy	<ul> <li>The students are able to find necessar judge their quality.</li> <li>During the semester the students are exercises. Based on this knowledge the students.</li> </ul>	able to check their learning	g progress	continuously i
Workload in Hours	  Independent Study Time 124, Study Time in Leo	cture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculat			
	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: Com General Engineering Science (English program)	<ul><li>): Specialisation Bioprocess E am, 7 semester): Specialisa m, 7 semester): Specialisation pulsory</li></ul>	ngineering: ation Proce on Bioproce	Compulsory ss Engineering ss Engineering

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
Process Engineering: Core qualification: Compulsory

	quilibria Thermodynamics
	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	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, 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: 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. C 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>

Course L0140: Phase Equilibria Thermodynamics		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
	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: equilibrium condition, binary systems</li> <li>Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> <li>The students work on tasks in small groups and present their results in front of all students.</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 L0142: Phase Equilibria Thermodynamics	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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. C Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>

Typ Hrs/wk CP Signals and Systems (L0432)  Module Responsible   Prof. Gerhard Bauch  Module Responsible   Prof. Gerhard Bauch  Mathematics 1-3  Recommended   Previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge   The module is an introduction to the theory of signals and systems from the signal. The students are able to classify and describe signals and linear time-invariant (UT) systems using the students are able to classify and describe signals and linear time-invariant (UT) systems using the signal to a discrete-time signals and systems. They can describe and analyse deterministic signals and linear time-invariant in the signal. The students are able to describe and analyse deterministic signals and linear time-invariant programs and signal to a discrete-time signal and systems theory. They can analyse and design basic systems reporder important, properties such as magnitude and phase response, stability, linearity etc. They can asset to students are able to describe and analyse deterministic signals and linear time-invariant programs and the signal properties in time and frequency domain.  The students are able to acquire relevant information from appropriate literature sources. They can asset to stude		
Signals and Systems (L0432)  Module Responsible   Prof. Gerhard Bauch   None   Rectation Section (small)   2   2   2    Module Responsible   Prof. Gerhard Bauch   None   Requirements   None	Courses	
Module Responsible Prof. Gerhard Bauch  Admission Requirements  Mathematics 1-3  Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge by the moduls Mathematic 1-3 is expected. Further experience with spectral transformations (Fouriser's Fourier transform, Laplace transform) is useful but not required.  Educational Objectives  Affect taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (UTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations.  Knowledge in the students are able to classify and describe signals and systems. They can describe and analyse determinist 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 the impact of LTI systems on the signal properties in time and signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system such as a signal and systems theory. They can analyse and design basic systems regarding using methods of signal and system theory. They can analyse and design basic systems regarding the students are able to describe and analyse deterministic signals and linear time-invariant system such as a signal and system response, stability. Ilinearity 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 problems.  The students are able to acquire relevant information from appropriate literature sources. They can describe an advantage of the students are able to acquire relevant information from appropriate systems.  Great Engineering Science (German program): Specialisation Electrical Engin		71
Module Responsible   Prof. Gerhard Bauch   Admission   None   Mathematics 1-3   Mathematics 1-4   Mathematics 1-5   Math		
Recommended Previous Knowledge Previous Knowledge Professional Competence  The students are able to classify and describe signals and systems. Good knowledge in maths as cover series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence  The students are able to classify and describe signals and linear time-invariant (I/II) systems using methods of signal and system theory. They are able to apply the fundamental transformation signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand the signals to a discrete-time signal.  The students are able to describe and analyse deterministic signals and signal to a discrete-time signal.  The students are able to describe and analyse and design basic systems requaring the signal to a discrete-time signal.  The students are able to describe and analyse and design basic systems requaring the signal properties in time domain and image domain which are caused by the transition of a continuous-time and signal and system theory. They can analyse and design basic systems requaring the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They or automation and scale to the students are able to acquire relevant information from appropriate literature sources. They or acquired the summation duration and scale to the students are able to acquire relevant information from appropriate literature sources. They or acquired the summation duration and scale to the students are additionally to the summation of the summation duration and scale series of the summation duration and scale series of the summation duration and scale series of the summation duration and scale series of the summation		
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Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fouriseries, Fourier transform, Lapface transform) is useful but not required.  Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (III) systems using methods of signal and systems theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular they understand the signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and innear time-invariant system in the students are signal and systems theory. They can analyse and design basis they understand the impact of LIT systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They can active the impact of LIT systems on the signal properties in time and frequency domain.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination  Examination Written exam  Examination duration  General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedic		None
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Professional Competence  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 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 students are able to describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to the signal properties in time and frequency domain.  Personal Competence  Personal Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They can asset to control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination duration and scale  General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Depress Engineering Compulsory General Engineering Science	Educational Objectives	After taking part successfully, students have reached the following learning results
The students are able to classify and describe signals and linear time-invariant (ITI) 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 teffects 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 the important properties such as magnitude and phase response, stability, linearity etc They can asse the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Deprocess Engineering Compulsory General Engineering Science (German program, 7 semester): Specialis		
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Autonomy  Control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration 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 Drocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Biomedical 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 Biomechanics: 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 Sciences (German program, 7 semester): Specialisation Mechanical Engineering Focus Mat	Social Competence	The students can jointly solve specific problems.
Independent Study Time 110, Study Time in Lecture 70   Credit points	Autonomy	control their level of knowledge during the lecture period by solving tutorial problems, software too
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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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

	and Systems
Тур	Lecture
Hrs/wk	
СР	
	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 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, Stuttga 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 (small)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0938: B	ioprocess Engineering - Fun	damentals		
Courses				
<b>Title</b> Bioprocess Engineering - Fu Bioprocess Engineering- Fur		<b>Typ</b> Lecture Recitation Section (large) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Andreas Liese			
Admission Requirements				
Recommended Previous Knowledge	Inone module "organic chemistry" modul	le "fundamentals for process engi	neering"	
	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	Students are able to describe the basic different types of kinetics for enzymes an inhibition. The parameters of stoichiomel in bioreactors can be explained. The management, sterilization technology and After successful completion of this modul	nd microorganisms, as well as to d try and rheology can be named a students are capable to expl d downstream processing in detai	ifferentiate d nd mass trar ain fundame	ifferent types of sport processes
Skills	<ul> <li>describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters</li> <li>predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process</li> <li>analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations</li> <li>distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem</li> <li>propose solutions to complicated biotechnological problems and to deduce the corresponding 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>			
Personal Competence  Social Competence	After completion of this module particip	osition to their own opinions and		
Autonomy	After completion of this module partici independently by organizing their workflo			olem in a team
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	I			
	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula			Compulsory ss Engineering: ess Engineering: Compulsory mpulsory ss Engineering: ess Engineering: mpulsory ory compulsory	

Course L0841: Bioproce	ess Engineering - Fundamentals
Тур	Lecture
Hrs/wk	2
СР	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>Technology of sterilization (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>

Course L0842: Bioproce	ess Engineering- Fundamentals
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
	1. Introduction (Prof. Liese, Prof. Zeng)
	2. Enzymatic kinetics (Prof. Liese)
	3. Stoichiometry I + II (Prof. Liese)
	4. Microbial Kinetics I+II (Prof. Zeng)
Content	5. Rheology (Prof. Liese)
Content	6. Mass transfer in bioprocess (Prof. Zeng)
	7. Continuous culture (Chemostat) (Prof. Zeng)
	8. Sterilisation (Prof. Zeng)
	9. Downstream processing (Prof. Liese)
	10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)
Literature	siehe Vorlesung

Course L0843: Bioproce	ess Engineering - Fundamental Practical Course
Тур	Practical Course
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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

Module M0538: H	leat and Mass Transfer			
Courses				
Title Heat and Mass Transfer (L0 Heat and Mass Transfer (L0 Heat and Mass Transfer (L1)	102)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible		rectation section (large)	-	
Admission				
Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of explaining que procedural apparatus (e. g. heat exchange)</li> <li>They are capable of distinguish and charanter capable of heat transfer and the students have the ability to explain describe mass transfer qualitative and qualitative are able to depict the analogy between linked processes in detail.</li> </ul>	er, chemical reactors).  racterize different kinds of I thermal radiation.  the physical basis for man antitative by using suitable	heat transf ss transfer i mass transfe	fer mechanisms in detail and to er theories.
Skills	<ul> <li>The students are able to set reasonable using the gained knowledge and to be respectively.</li> <li>They are capable to solve specific hear temperature alteration in fluids) and to cale.</li> <li>Using dimensionless quantities, the stude apparatus.</li> <li>They are able to distinguish between differ they can use this knowledge for the descretification column).</li> <li>In this context, the students are capable mass exchanger for a specific application respectively.</li> <li>In addition, they can calculate both, stead apparatus.</li> <li>The students are capable to connect their other courses (In particular the courses the engineering) to solve concrete technical process.</li> </ul>	transfer problems (e.g. culate the corresponding hents can execute scaling usion, convective mass training and design of apparato choose and design function considering their advants dy-state and non-steady-state knowledge obtained in this permodynamics, fluid mech	heated che eat flows. p of technic ensition and tus (e.g. ext damental typhtages and eate processes course with	nd mass flow, emical reactors, cal processes or mass transfer. craction column, pes of heat and disadvantages, es in procedural th knowlegde of
Personal Competence				
Social Competence	The students are capable to work on sul results orally in a reasonable manner to tu	, .	teams and	to present the
Autonomy	<ul> <li>The students are able to find and evaluate</li> <li>They are able to prove their level of know continuously (clicker-system, exam-like a learning processes.</li> </ul>	ledge during the course wit	h accompar	nying procedure
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	1 1 20 minutes, theoretical difestions and calculation	ons		
	General Engineering Science (German program	n, 7 semester): Specialis	ation Proce	ss Engineering:

Assignment for the Following Curricula	
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Course L0101: Heat and Mass Transfer			
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	1. Heat transfer  Introduction, one-dimensional heat conduction  Convective heat transfer  Multidimensional heat conduction  Non-steady heat conduction  Thermal radiation  Mass transfer  one-way diffusion, equimolar countercurrent diffusion  boundary layer theory, non-steady mass transfer  Heat and mass transfer single particle/ fixed bed  Mass transfer and chemical reactions		
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer     VDI-Wärmeatlas		

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

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

Module M0546: T	hermal Separation Processes			
Title Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141)		Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 2 2 1
Separation Processes (L115	· 1	Practical Course	1	1
Module Responsible  Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can distinguish and describe different types of separation processes such as distillation, extraction, and adsorption</li> <li>The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems</li> <li>They have good knowledge of designing methods for separation processes and devices</li> </ul>			
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a giver 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 process 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 based on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties from 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 of the experimenta work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>The students can work technical assignments in small groups and present the combined rein the tutorial</li> <li>The students are able to carry out practical lab work in small groups and organize a function division of labor between them. They are able to discuss their results and to document scientifically in a report.</li> </ul>		ize a functiona	
Autonomy	<ul> <li>The students are capable to obtain the needed information from suitable sources by themselves and assess their quality</li> <li>The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculation			
	General Engineering Science (German program Compulsory General Engineering Science (German program,			

Assignment for the Following Curricula	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 Environmental
	Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course 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 Technischen Chemie</li> </ul>

Course L0119: Thermal	Separation Processes
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> The students work on tasks in small groups and present their results in front of all students.
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>

Course 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>

Course L1159: Separation Processes				
Тур	Practical Course			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.			
Lecturer	Prof. Irina Smirnova			
Language	DE/EN			
Cycle	WiSe			
Content	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.  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 on their own reports and level of scientific writing so they can increase their capabilities in this area.  Topics of the practical course:  Introduction in the thermal process engineering and to the main features of separation processes  Simple equilibrium processes, several steps processes  Distillation of binary mixtures, enthalpy-concentration diagrams  Extractive and azeotrope distillation, water vapor distillation, stepwise distillation  Extraction: separation ternary systems, ternary diagram  Multiphase separation including complex mixtures  Designing of separation devices without discrete stages  Drying  Chromatographic separation processes  Membrane separation  Energy demand of separation processes  Advance overview of separation processes  Advance overview of separation processes  Selection of separation processes			
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: C	hemical Reaction Engineering			
Courses				
Title Chemical Reaction Engineering (Fundamentals) (L0204) Chemical Reaction Engineering (Fundamentals) (L0244) Experimental Course Chemical Engineering (Fundamentals) (L0221)		Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Raimund Horn			
Admission Requirements				
	Contents of the previous modules mathematics I as well as computational methods for engineers.	-III, physical chemistry, tec	hnical therr	nodynamics I+II
	After taking part successfully, students have read	thed 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.			
Skills	After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors , - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines.			
Personal Competence				
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers.			
Autonomy	The students are able to obtain further information and assess their relevance autonomously. Students can apply their knowldege discretely to plan, prepare and conduct experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination				
Examination duration and scale	120 min			
	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 Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory			

ourse L0204: Chemica	al Reaction Engineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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)

Content

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, Damköhlernumber, 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		
СР	2		
<b>Workload in Hours</b>	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 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, molebalance 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

Module M0945: B	Sioprocess Engineering - Advanced			
Courses				
<b>Title</b> Bioprocess Engineering - Ac Bioprocess Engineering - Ac		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible	Prof. An-Ping Zeng			
Admission Requirements	LNODE			
Recommended Previous Knowledge	II ONTENT OF MODILIE "BIOCHEMICAL ENGINEERING I"			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence	After successful completion of this module, students should be able to			
Knowledge	<ul> <li>describe and explain different kinetic approaches for growth and substrate-uptake</li> <li>identification of scientific problems with concrete industrial use (cultivation of microorganisms and mammalian cells)</li> </ul>			
	<ul> <li>describe and explain important downstrea as basic immobilization methods</li> </ul>	ming steps for proteins a	nd their app	lication as well
	After successful completion of this module, studen			
	- to identifiy scientific questions or possible practical problems for concrete industrial applications (eg cultivation of microorganisms and animal cells ) and to formulate solutions ,			
	- To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to given problems (anaerobic , aerobic or microaerobically)			
	- to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions ,			
Skills	5 - To describe the effects of the energy generation, the regeneration of reduction equivalents , and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively			
	- Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and to calculate immobilization and activity yields ,			
	- to select process control strategies (batch , fed-batch , continuity ) appropriately and to calculate basic types and evaluate them.			
Personal Competence	! !			
Social Competence	After completion of this module participants should be able to debate technical questions in smal teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.			
Autonomy	After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previously unknown issues and to present these.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
	Written exam			
Examination duration and scale				
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

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	
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	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 Skripte für die Vorlesung	

Course L1108: Bioproce	ess Engineering - Advanced
	Recitation Section (small)
Hrs/wk	
СР	2
<b>Workload in Hours</b>	Independent 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> <li>The students present exercises and discuss them with their fellow students and faculty statt. In the PBL part of the class the students discuss scientific questions in teams. They acquire knowledge and apply it to unknown questions, present their results and argue their opinions.</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>

Module M1275: E	nvironmental Technology			
Courses				
<b>Title</b> Practical Exercise Environm Environmental Technologie	33	<b>Typ</b> Practical Course Lecture	Hrs/wk 1 2	<b>CP</b> 1 2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry an	d biology		
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	ng results	
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound knowledge of environmental 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 environmental problems. They are able to determine geochemical parameters and to assess the potential of 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 opinions 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 multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.			
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 in Lectu	ıre 42		
Credit points	3			
Examination				
Examination duration and scale	1 hour			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: 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			

Course L1387: Practica	Exercise Environmental Technology
Тур	Practical Course
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	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.
	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: Environi	mental Technologie
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, Dozenten des SD V
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)

Courses				
<b>Title</b> Introduction to Control Syst	ems (I 0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements	   Representation of signals and system	ns in time and frequency domain, Lapla	ice transform	<u> </u>
Recommended Previous Knowledge		is in time that frequency domain, Eaple	ice transform	'
Educational Objectives	After taking part successfully, studer	nts have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can i 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 term 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 frequenc 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 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 and frequen response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time a 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 controller designs	o jointly solve technical problems, and e	experimental	lly validate the
	-	rom provided sources (lecture notes solving given problems.	s, software	documentatio
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		ng progress.	
	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Examination duration	Written exam 120 min			
and scale				
	General Engineering Science (Ger Compulsory	man program, 7 semester): Specia	lisation Com	nputer Scienc
	General Engineering Science (Germ	an program, 7 semester): Specialisat	ion Bioproce	ss Engineerin
	Compulsory General Engineering Science (Ger	man program, 7 semester): Special	isation Nava	al Architectur
	Compulsory			
	Compulsory	rman program, 7 semester): Specia		
		nan program, 7 semester): Specialisa	ition Electric	al Engineerin
	Compulsory General Engineering Science (Germ	an program, 7 semester): Specialisat	ion Biomedic	cal Engineerin
	Compulsory General Engineering Science (Germ	an program, 7 semester): Specialisatio	n Energy ar	nd Environment
	Engineering: Compulsory		3,	
	General Engineering Science (Geri Compulsory	man program, 7 semester): Specialis	ation Proce	ss Engineerin
		an program, 7 semester): Specialisati	on Mechanio	cal 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
avT	Lecture
Hrs/wk	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M0539: P	rocess and Plant Engineering			
Courses				
Title Process and Plant Engineeri Process and Plant Engineeri Process and Plant Engineeri	ng I (L0096)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Georg Fied			
Admission Requirements	None			
Recommended Previous Knowledge	unit operation of thermal an dmechanical separation processes chemical reactor eingineering			
Educational Objectives Professional Competence	After taking part successfully, students hav	e reached the following learning	results	
	students can: classify and formulate blobal balance equat specify linear component equations of com explain linear regression and data reconcill explain pfd-diagrams	plex chemical processes		
Skills	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				
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. lectures notes and books			
	General Engineering Science (German procompulsory General Engineering Science (German procompulsory General Engineering Science (German procompulsory General Engineering Science (German procompulsory Bioprocess Engineering: Core qualification: General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory Engineering: Elective Compulsory Process Engineering: Core qualification: Con	gram, 7 semester): Specialisation gram, 7 semester): Specialisation Compulsory ogram, 7 semester): Specialisation gram, 7 semester): Specialisation	on Bioproce  n Energy an  ation Proces  on Bioproce	ss Engineering d Enviromenta ss Engineering ss Engineering

Course 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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg	
Language	DE	

Cycle	SoSe
Content	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
Literature	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 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. 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, Ohssertation, TU München, 1987 G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	<ul> <li>G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98</li> <li>H.J. Lang, Chem. Eng. 54(10),117, 1947</li> <li>H.J. Lang, Chem. Eng. 55(6), 112, 1948</li> </ul>

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
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course 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
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0670: P	article Technology and Solids	Process Engineering		
Courses				
Title Particle Technology I (L0434) Particle Technology I (L0445) Particle Technology I (L0446)	5)	Typ Lecture Recitation Section (small) Practical Course	Hrs/wk 2 1 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous Knowledge	keine			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence		udents are able to		
Knowledge	<ul> <li>After successful completion of the module students are able to</li> <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	• choose and design apparatuses and processes for solids processing according to the desired solids properties of the product     • asses solids with respect to their behavior in solids processing steps     • document their work scientifically.			
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 quest	tions regarding solid particles in	dependently	/.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination				
Examination duration and scale				
Assignment for the Following Curricula				

Course L0434: Particle	Technology 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>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>
	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.

rse L0435: Particle	rse L0435: Particle Technology I			
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	1			
<b>Workload in Hours</b>	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 LOAAO, Bortisla	7
Course L0440: Particle	Technology 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: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the import Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Economy Management and to name important definiti. • explain the most important aspects of and easpects of entreprneurial projects. • describe and explain basic business function chain management, organization and human innovation management and marketing. • explain the relevance of planning and decompultiple objectives and uncertainty, and Finance. • state basics from accounting and costing and	larketing and Innovation, nics and Management a ons from the field of Mana goals in Management and ns as production, procure n ressource management cision making in Busines explain some basic me	and also to I and the sub agement d name the ement and so , information s, esp. in si ethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence	Students are able to			
Social Competence	<ul> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
	Students are able to			
Autonomy		emselves		
Workland ! !!				
Credit points	Independent Study Time 110, Study Time in Lectur	e /U		
•	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M1274: E	nvironmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment	· · · ·	Lecture	2	2 1
Environmental Assessment		Recitation Section (small)	1	1
Module Responsible Admission	Prof. Martin Kaltschmitt			
Requirements	INODE			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry and	biology		
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Competence	! !	acquire in-depth knowledg	e of importa	int cause-effect
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 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.			
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 EcoInvent. 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 and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business context and are able to judge results of other publications.			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	e 42		
Credit points	3			
	Written exam			
Examination duration and scale	I I hour wriften exam			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory Process Engineering: Core qualification: Elective Compulsory Process Engineering: Core qualification: Elective Compulsory Process Engineering: Core qualification: Elective Compulsory			

Course L0860: Environi	mental 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
	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
Content	Life cycle concept: Life cycle assessment (LCA)
	<b>Sustainability</b> : Comprehensive product system assessment , SEE-Balance
	<b>Management</b> : Environmental and Sustainability management (EMAS)
	Complex systems: MCDA and scenario method
	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich
Literature	GmbH)

Course L1054: Environ	mental 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, Dr. Anne Rödl
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				
Fitle Circuit Theory (L0566) Circuit Theory (L0567)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Arne Jacob			
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I an	d II		
ducational Objectives	After taking part successfully, students have rea	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 transier analysis of linear networks in time and in frequency domain, and they are able to explain the frequence behaviour and the synthesis of passive two-terminal-circuits.			
Skills	The students are able to calculate currents and also when driven by periodic signals. They are and frequency domain and are able to explain analyse and to synthesize the frequency behavi	able to calculate transients n the respective transient b	in electrical ehaviour. Th	circuits in tim
Personal Competence  Social Competence	Students work on exercise tasks in small guide their results within the group.	ed groups. They are encoura	ged to pres	ent and discus
Autonomy	The students are able to find out the requir Possibilities are given to test their knowledge of tests. This allows them to control independently knowledge to other courses like Electrical Engin	during the lectures continuou their educational objectives	ısly by mea	ns of short-tim
Workload in Hours	Independent Study Time 110, Study Time in Lec	cture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
	General Engineering Science (German program) General Engineering Science (German prog Mechatronics: Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory	gram): Specialisation Mech	anical Engi	neering, Focu

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

ourse L0566: Circuit Theory		
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 T	ourse 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: C	Computer Engineering			
Courses				
Title Computer Engineering (L03 Computer Engineering (L03	21) Le	<b>yp</b> ecture ecitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	· · · · · · · · · · · · · · · · · · ·	,		
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge		ent is granted a bonus o examination's marks	n the exami are lifted b	nation's marks
<b>Educational Objectives</b>	After taking part successfully, students have reached	the following learning r	esults	
Professional Competence				
Knowledge	Introduction     Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesic combinational networks     Sognational logic: Flip floors systematic bardware design.		ure, pipelining	
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify internal structure and the physical composition of computer systems. The students can analyze, highly specific and individual computers can be built based on a collection of few and sim components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors.  Shafter successful completion of the module, the students are able to judge the interdependent 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 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 proportions.		n analyze, how w and simple ction layers o rdependencies lar, they shal ric abstraction o evaluate the	
Personal Competence				
	Students are able to solve similar problems alone or i			
Autonomy	Students are able to acquire new knowledge from s with other classes.	specific literature and to	associate t	his knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
Examination duration	190 minutes contents of course and lans			
and scale	   General Engineering Science (German program): Core   General Engineering Science (German program,			outer Science
	Compulsory General Engineering Science (German program, 7 s Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program,	7 semester): Specialis	ation Naval	Architecture
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 s Compulsory	·		
	1 101			

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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** 

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 Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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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	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 M0567: T	heoretical Electrical Engineer	ring I: Time-Independe	nt Field	S
Courses				
_	eering I: Time-Independent Fields (L0180) eering I: Time-Independent Fields (L0181)	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 5 1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous Knowledge	Basic principles of electrical engineering ar	nd advanced mathematics		
<b>Educational Objectives</b>	After taking part successfully, students hav	ve reached the following learning	results	
Professional Competence				heory of time-
Knowledge	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 can assess the principal effects of given time-independent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications.			
Personal Competence  Social Competence	Students are able to work together on sub their results effectively (e.g. during exercis		s. They are	able to present
Autonomy	Students are capable to gather necessary information from provided references and relate this 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 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 i	n Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
	General Engineering Science (German progeneral Engineering Science (German progeneral Engineering Science (German progeneral Engineering: Core qualification: C General Engineering Science (English progeneral Engineering Science (English progeneral Engineering Science (English progeneral Engineering Science (English progeneral Engineering: Compulsory Computational Science and Engineering: Compulsory Technomathematics: Specialisation III. Eng	rogram, 7 semester): Specialisa Compulsory ram): Specialisation Electrical Engogram, 7 semester): Specialisat Specialisation Mathematics & En	tion Electric Jineering: Co cion Electric gineering S	al Engineering: ompulsory al Engineering:

Course L0180: Theoretical Electrical Engineering I: Time-Independent Fields		
Тур	Lecture	
Hrs/wk	3	
СР	5	
	Independent Study Time 108, Study Time in Lecture 42	
-	Prof. Christian Schuster, Prof. Frank Gronwald	
Language		
Cycle	- Maxwell's Equations in integral and differential notation	
	- Boundary conditions	
	- Laws of conservation for energy and charge	
	- Classification of electromagnetic field properties	
	- Integral characteristics of time-independent fields (R, L, C)	
	- Generic approaches to solving Poisson's Equation	
Content	- Electrostatic fields and specific methods of solving	
	- Magnetostatic fields and specific methods of solving	
	- Fields of electrical current density and specific methods of solving	
	- Action of force within time-independent fields	
	- Numerical methods for solving time-independent problems	
	- 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)	

Course L0181: Theoretical Electrical Engineering I: Time-Independent Fields		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
	Independent Study Time 2, Study Time in Lecture 28	
-	Prof. Christian Schuster	
Language		
Cycle	- Maxwell's Equations in integral and differential notation	
	·	
	- Boundary conditions	
	- Laws of conservation for energy and charge	
	- Classification of electromagnetic field properties	
	- Integral characteristics of time-independent fields (R, L, C)	
	- Generic approaches to solving Poisson's Equation	
Content	- Electrostatic fields and specific methods of solving	
	- Magnetostatic fields and specific methods of solving	
	- Fields of electrical current density and specific methods of solving	
	- Action of force within time-independent fields	
	- Numerical methods for solving time-independent problems	
	- 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)	

Module M0748: M	laterials in Electrical Engine	ering		
Courses				
Title Electrotechnical Experiment Materials in Electrical Engin Materials in Electrical Engin		<b>Typ</b> Lecture Lecture Recitation Section (small)	Hrs/wk 1 2 2	<b>CP</b> 1 3 2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous Knowledge		es .		
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached 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 to the content of the lecture. of lecture accompanying measures such their knowledge with that acquired from the content of the conte	They can reflect their acquired lev as exam typical exam questions. S	el of experti	se with the help
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German pro General Engineering Science (German Compulsory Electrical Engineering: Core qualification: General Engineering Science (English pro General Engineering Science (English pro Compulsory Computational Science and Engineering:	program, 7 semester): Specialisa Compulsory gram): Specialisation Electrical Eng program, 7 semester): Specialisa	tion Electric gineering: Co tion Electric	cal Engineering: ompulsory cal Engineering:

Course L0714: Electrot	echnical Experiments
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 16, Study Time in Lecture 14
	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	

Course L0685: Materia	ls in Electrical Engineering
Тур	Lecture
Hrs/wk	2
СР	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Manfred Eich
Language Cycle	
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
Literature	Magnetic domains  1.Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials, Massachusetts Institute of Technology (MIT), 2013  2.Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004  3.Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994  4.Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994  5.Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979  6.Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004  7.Ashcroft, Mermin, Solid State Physics, Harcourt, 1976  8.Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988  9.Sze, Physics of Semiconductor Devices, Wiley, 1981  10.Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007  11.Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2008  12.Handley, Modern Magnetic Materials, Wiley, 2000  13.Wikipedia, Wikimedia

Course L0687: Materials in Electrical Engineering (Problem Solving Course)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	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)	

Courses			
Title	Typ Hrs/wk CP		
Signals and Systems (L0432 Signals and Systems (L0433			
-			
Module Responsible Admission			
Requirements	None		
	Mathematics 1-3		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covere by the moduls Mathematik $1-3$ is expected. Further experience with spectral transformations (Fourie series, Fourier transform, Laplace transform) is useful but not required.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional			
Competence			
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 to a discrete-time signal.		
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant syster using methods of signal and system theory. They can analyse and design basic systems regardir 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 problems.		
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They c control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
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): 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 Civil- and Environmental Engeneerin 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory 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 Biomedical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Foc		
	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneerir		

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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0432: Signals	and 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 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 (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0709: Electrical Engineering IV: Transmission Lines and Research Seminar				
Courses				
Title		Typ Seminar Lecture Recitation Section (large)	Hrs/wk 2 2 2	<b>CP</b> 2 3 1
Module Responsible	Prof. Arne Jacob			
Admission Requirements	INODA			
Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the fundamentals of wave propagation on transmission lines at low and high frequencies. They are able to analyze circuits with transmission lines in time and frequency domain. They can describe simple equivalent circuits of transmission lines. They are able to solve problems with coupled transmission lines. They can present and discuss a self-chosen research topic.			
Skills	Students can analyze and calculate the propagatic They are able to analyze circuits in frequency d equivalent circuits of transmission lines. They are a lines using the vectorial transmission line equation	omain and with the Smitable to solve problems inc	th chart. The	ney can analyze led transmission
Personal Competence  Social Competence	Students can analyze and solve problems in small groups and discuss their solutions. They can compare the learned theory with experiments in the lecture and discuss it in small groups. They are able to present a research topic to professionals and discuss it with them.			
Autonomy	The students can solve problems by their own and are able to acquire skills from the lecture and the 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 their 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			
Assignment for the Following Curricula	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 Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: 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		
Typ 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	
СР	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	

Module M0854: Mathematics IV			
Courses			
Differential Equations 2 (Par		Typ Lecture Recitation Section (small) Recitation Section (large) Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk CP  2 1 1 1 1 1 2 1 1 1 1 1 1 1
Module Responsible	Prof. Anusch Taraz		
Admission Requirements	None		
Recommended Previous Knowledge			
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learning	results
Professional Competence			
Knowledge	<ul> <li>Students can name the basic conceappropriate examples.</li> <li>Students can discuss logical confillustrating these connections with the theorem in the strategies and can be strategies.</li> </ul>	nections between these concepthe help of examples.	
Skills	<ul> <li>Students can model problems in M course. Moreover, they are capable</li> <li>Students are able to discover an studied in the course.</li> <li>For a given problem, the students corritically evaluate the results.</li> </ul>	of solving them by applying establed verify further logical connections	olished methods. ons between the concepts
Personal Competence  Social Competence	<ul> <li>Students are able to work together language.</li> <li>In doing so, they can communicate</li> </ul>	e new concepts according to the	needs of their cooperating
Autonomy	<ul> <li>Students are capable of checking to can specify open questions precisel</li> <li>Students have developed sufficient oriented manner on hard problems.</li> </ul>	y and know where to get help in s persistence to be able to work f	olving them.
Workload in Hours	Independent Study Time 68, Study Time in	n Lecture 112	
Credit points			1
Examination Examination duration	Written exam	Toward Front ( )	
and scale	60 min (Complex Functions) + 60 min (Dir		
	General Engineering Science (German pro General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Theoretical Mechanical Engineering: Comp General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German Compulsory	program): Specialisation Mech program): Specialisation Mech pulsory gram): Specialisation Naval Archit program, 7 semester): Specialisation gram, 7 semester): Specialisation gram, 7 semester): Specialisation cogram, 7 semester): Specialisation	anical Engineering, Focus anical Engineering, Focus ecture: Compulsory tion Electrical Engineering: on Mechanical Engineering, on Mechanical Engineering,

	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			
Accionmont for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus			
Assignment for the	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 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			

urse L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations  • Examples of partial differential equations  • First order quasilinear differential equations  • Normal forms of second order differential equations  • Harmonic functions and maximum principle  • Maximum principle for the heat equation  • Wave equation  • Liouville's formula  • Special functions  • Difference methods  • Finite elements	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

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: Differen	urse L1045: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	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 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	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html		

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

Course 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

				<u> </u>
Courses				
	ions and Random Processes (L0442) ions and Random Processes (L0443)	<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have	e reached 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.			
<b>Personal Competence</b>				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6		<u> </u>	
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Тур	Lecture		
Hrs/wk	3		
СР	4		
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Gerhard Bauch		
Language			
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> </ul>		
	Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyqu condition, matched filter, detection, error probability     Fundamentals of digital modulation  Kammayarı Nashrichtenühertragung, Tayıbnar		
	<ul><li>K. Kammeyer: Nachrichtenübertragung, Teubner</li><li>P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.</li><li>M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.</li></ul>		
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.		
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.		
	S. Haykin: Communication Systems. Wiley		
Literature	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.		
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.		

Course 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: E	lectrical Power Systems I: Introd	uction to Electrical	Power :	Systems
Courses				
=	Introduction to Electrical Power Systems (L1670) Introduction to Electrical Power Systems (L1671)	<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			
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	Students are able to give an overview of convex explain in detail and critically evaluate tech storage, and distribution as well as integration of the control of the contr	nologies of electric power	generation	i, transmission,
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				
Social 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	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory			

Тур	Lecture
Hrs/wk	3
СР	
<b>Workload in Hours</b>	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> </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> <li>K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflag</li>
Literature	2013  A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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> </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> <li>K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflar</li>
Literature	2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Module M0783: M	leasurements: Methods and	Data Processing		
Courses				
Title EE Experimental Lab (L0781 Measurements: Methods and Measurements: Methods and	d Data Processing (L0779)	<b>Typ</b> Practical Course Lecture Recitation Section (small)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous Knowledge	principles of mathematics principles of electrical engineering			
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learning i	results	
Professional Competence	The students are able to explain the p			
Knowledge	measurements. They can detail aspects stochastic signals. Students know method			e processing of
Skills	The students are able to evaluate prob processing of measurements.	olems of metrology and to apply n	nethods for	describing and
Personal Competence	<u>'</u>			
Social Competence	The students solve problems in small gro	oups.		
Autonomy	The students can reflect their knowledge	and discuss and evaluate their resu	ults.	
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	I			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German Elective Compulsory Electrical Engineering: Core qualification: General Engineering Science (English Elective Compulsory Computational Science and Engineering: Computational Science and Engineering:	: Compulsory program, 7 semester): Specialisat Specialisation Computer Science: E	ion Electric	al Engineering:
	Technomathematics: Specialisation III. Er			

Course L0781: EE Expe	ourse L0781: EE Experimental Lab		
Тур	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			
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		

Module M0760: E	lectronic Devices			
Courses				
<b>Title</b> Electronic Devices (L0720) Electronic Devices (L0721)		<b>Typ</b> Lecture Project-/problem-based Learning	<b>Hrs/wk</b> 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Hoc Khiem Trieu	J		
Admission Requirements	None			
Recommended Previous Knowledge	Atomic model and quantum theory, electrical physics Successful participation of Physics for Engineer equivalent contents			
<b>Educational Objectives</b>	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	to represent the basics of semiconductor     to explain the operating principle of imposite to outline device characteristics and equipage to discuss the limitation of device models.	ortant semiconductor devices		derivation and
Skills	to apply devices in basic circuits,     to realize the physical context and to solve.	ve complex problems by one	self	
Personal Competence				
Social Competence	Students are able to prepare and perform their discuss the results in front of audience.	lab experiments in team wo	rk as well as	s to present and
Autonomy	Students are capable to acquire knowledge bas	ed on literature in order to p	repare their	experiments.
Workload in Hours	Independent Study Time 110, Study Time in Led	cture 70		
Credit points				
	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory Electrical Engineering: Core qualification: Comp General Engineering Science (English progra Compulsory Computational Science and Engineering: Special	ulsory m, 7 semester): Specialisa	tion Electric	cal Engineering:

Course L0720: Electron	ic Devices
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Hoc Khiem Trieu
Language	
Cycle	<ul> <li>Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor 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, tunnel diode, backward diode, photo diode, LED, laser diode)</li> <li>Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of</li> </ul>
Literature	S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011)  T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004)  B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)  D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)  M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996)  S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007)  H. Schaumburg: Halbleiter, B.G. Teubner (1991)  A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992)  HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

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Jourse LU/21: Electron	urse L0721: Electronic Devices		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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		

Courses				
<b>Title</b> Introduction to Control Syst	ems (I 0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements	   Representation of signals and system	ns in time and frequency domain, Lapla	ace transform	า
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, studer	nts 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 at 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 frequen response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time at 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	1	jointly solve technical problems, and	experimental	ly validate the
	controller designs   Students can obtain information f   experiment guides) and use it when	rom provided sources (lecture notes solving given problems.	s, software	documentation
Autonomy	They can assess their knowledge in v	veekly on-line tests and thereby contro	l their learnii	ng progress.
	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6   Written exam			
Examination duration				
and scale				
	General Engineering Science (Ger Compulsory	man program, 7 semester): Specia	lisation Com	nputer Scienc
	General Engineering Science (Germ	an program, 7 semester): Specialisat	ion Bioproce	ss Engineerin
	Compulsory General Engineering Science (Gen	man program, 7 semester): Specia	isation Nava	al Architectur
	Compulsory			
	General Engineering Science (Ger Compulsory	rman program, 7 semester): Speci	alisation Civ	ııı Engineerin
	General Engineering Science (Germ	nan program, 7 semester): Specialisa	ation Electric	al Engineerin
	Compulsory General Engineering Science (Germ	an program, 7 semester): Specialisat	ion Biomedic	cal Engineerin
	Compulsory			5
	General Engineering Science (Germa Engineering: Compulsory	an program, 7 semester): Specialisation	on Energy ar	ia Enviroment
		nan program, 7 semester): Specialis	sation Proces	ss Engineering
		an program, 7 semester): Specialisati	on Mechanic	al 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion 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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

Course L0655: Introduc	urse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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				
	eers II: Time-Dependent Fields (L2283) eers II: Time-Dependent Fields (L2284)	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 5 1
	Prof. Christian Schuster			
Admission Requirements	None			
Recommended	Electrical Engineering I, Electrical Engineer	ing II, Theoretical Electrical Engin	eering I	
	Mathematics I, Mathematics II, Mathematic	s III, Mathematics IV		
<b>Educational Objectives</b>	After taking part successfully, students hav	ve reached the following learning	results	
Professional Competence				
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of 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 fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equatio for general time-dependent field problems. They can assess the principal effects of given time dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantitie for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiatio resistance, etc.) from given fields and interpret them with regard to practical applications.			
Personal Competence				
	Students are able to work together on subject related tasks in small groups. They are able to preser their results effectively (e.g. during exercise sessions).			
Autonomy	Students are capable to gather necessary information from provided references and relate th 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 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 acquired knowledge and ongoin research at the Hamburg University of Technology (TUHH), e.g. in the area of high frequence engineering and optics.			
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
	Written exam			
Examination duration and scale	120 min			

ourse L2283: Electron	nagnetics for Engineers II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
СР	5
	Independent Study Time 108, Study Time in Lecture 42
	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
	The practical application of numerical methods will be trained within specifically prepared lectures i an interactive manner using small MATLAB programs.
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
Literature	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
2.10.414	- 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)

Course L2284: Electromagnetics for Engineers II: Time-Dependent Fields		
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	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0777: S	emiconductor Circuit Design			
Courses				
<b>Title</b> Semiconductor Circuit Designonic Des	, ,	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of electrical engineering  Basics of physics, especially semiconductor p	physics		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to explain the functi</li> <li>Students are able to explain how analoge</li> <li>Students are able to explain the functions</li> <li>Students know the fundamental digit disadvantages.</li> <li>Students have knowledge about misspecifications.</li> <li>Students know the appropriate fields for the function of the fundamental digit disadvantages.</li> </ul>	og circuits functions and where ctionality of fundamental oper ital logic circuits and can dis emory circuits and can expl	they are ap rational amp cuss their a ain their fu	plied. lifiers and thei advantages and
Skills	<ul> <li>Students can calculate the specification of electronic circuits.</li> <li>Students are able to develop differe circuits.</li> <li>Students can use MOS devices, op applications.</li> </ul>	ent logic circuits and can des	ign different	types of logi
Personal Competence	Students are able work efficiently in he	eterogeneous teams.		
Social Competence	<ul> <li>Students working together in small questions.</li> </ul>	l groups can solve problems	and answ	er professiona
Autonomy	Students are able to assess their level	of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	120 111111			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatronics: Compulsory Electrical Engineering: Core qualification: 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 II. Mathematics & Engineering Science: Elective Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Тур	Lecture
Hrs/wk	3
СР	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	<ul> <li>Repetition Semiconductorphysics and Diodes</li> <li>Functionality and characteristic curve of bipolar transistors</li> <li>Basic circuits with bipolar transistors</li> <li>Functionality and characteristic curve of MOS transistors</li> <li>Basic circuits with MOS transistors for amplifiers</li> <li>Operational amplifiers and their applications</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Basic circuits with MOS transistors for combinational logic</li> <li>Memory circuits</li> <li>Basic circuits with MOS transistors for sequential logic</li> <li>Basic concepts of analog-to-digital and digital-to-analog-converters</li> </ul>
Literature	<ul> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflag 2012, ISBN 3540428496</li> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISE 047170055S</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berl 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>

Тур	Recitation Section (small)
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	<ul> <li>Basic circuits and characteristic curves of bipolar transistors</li> <li>Basic circuits and characteristic curves of MOS transistors for amplifiers</li> <li>Realization and dimensioning of operational amplifiers</li> <li>Realization of logic functions</li> <li>Basic circuits with MOS transistors for combinational and sequential logic</li> <li>Memory circuits</li> <li>Circuits for analog-to-digital and digital-to-analog converters</li> <li>Design of exemplary circuits</li> </ul>
	<ul> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496</li> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN 047170055S</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>

Module M0829: F	oundations of Management	
Courses		
Title Management Tutorial (L088 Introduction to Managemen		
Module Responsible	Prof. Christoph Ihl	
Admission Requirements		
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business	
	After taking part successfully, students have reached the following learning 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, 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 mathematical 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, 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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems	
Personal Competence	Students are able to	
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture to an entrepreneurship project and write a coherent	
	Students are able to	
Autonomy		
Workload in Hours	Independent Study Time 110. Study Time in Lecture 70	
Credit points	Independent Study Time 110, Study Time in Lecture 70	
·	Subject theoretical and practical work	
Examination duration and scale	several written exams during the semester	
	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 Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduction to Management		
Тур	Lecture	
Hrs/wk	3	
СР	3	
	Independent Study Time 48, Study Time in Lecture 42	
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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.	

Module M0734: E	lectrical Engineering Project Labo	ratory		
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering Projection	ct Laboratory (L0640)	Project-/problem-based Learning	8	6
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
	Electrical Engineering I, Electrical Engineering II			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned 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 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 knows solving practical problems. They identify and oprojects in the context of electrical engineering. conceptual solutions for non-standardized problem	vercome typical problem Students are able to dev	s during the	e realization of
Personal Competence				
Social Competence	Students are able to cooperate in small, mixe solutions to given problems in the context of elect and explain their results alone or in groups in from	rical engineering. They are it of a qualified audience.	e able to effe Students hav	ectively present we the ability to
Autonomy	Students are capable of independently solvin- literature. They are able to fill gaps in as well as a sources provided by the supervisor. Furthermore pragmatically solve them by means of correspond	extent their knowledge us , they can meaningfully e	ing the litera extend given	ature and other
Workload in Hours	l	e 112		
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and scale	inasen on rask + presentation			
Assignment for the	General Engineering Science (German program, Compulsory Electrical Engineering: Core qualification: Compuls General Engineering Science (English program, Compulsory Technomathematics: Specialisation III. Engineering	sory 7 semester): Specialisal	tion Electric	5

Course L0640: Electrica	al Engineering Project Laboratory
Тур	Project-/problem-based Learning
Hrs/wk	8
СР	6
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112
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 Environmental 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  $CO_2$  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  $CO_2$  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.

Title Computer Engineering (L0321) Computer Engineering (L0324) Recitation Section (small)  Module Responsible Prof. Heiko Falk  Admission Requirements  Recommended Previous Knowledge  The successful completion of the labs will be honored during the evaluation of the modul examination according to the following rules:  1. Upon a passed module examination, the student is granted a bonus on the examination's manual due to the successful labs, such that the examination's marks are lifted by 0,3 or 0 respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  This module deals with the foundations of the functionality of computing systems. It covers the lay from the assembly-level programming down to gates. The module includes the following topics:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining the evaluation of the CPU, principles of passing data, point-to-po connections, busses  The students perceive computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective, i.e., they identify the computer systems from the architect's perspective,	Module M0730: C	omputer Engineering			
Computer Engineering (L0321)  Computer Engineering (L0324)  Module Responsible   Prof. Heiko Falk  Admission Requirements   None    Basic knowledge in electrical engineering   The successful completion of the labs will be honored during the evaluation of the modul examination according to the following rules:  1. Upon a passed module examination, the student is granted a bonus on the examination's mark are lifted by 0,3 or 0 respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives   After taking part successfully, students have reached the following learning results  Professional Competence   This module deals with the foundations of the functionality of computing systems. It covers the lay from the assembly-level programming down to gates. The module includes the following topics:  • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer arithmetic: Integer addition, programming models, MIPS single-cycle architecture, pipelinit • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses	Courses				
Admission Requirements  Basic knowledge in electrical engineering The successful completion of the labs will be honored during the evaluation of the modul examination according to the following rules:  1. Upon a passed module examination, the student is granted a bonus on the examination's main due to the successful labs, such that the examination's marks are lifted by 0,3 or 0 respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives  Professional Competence  This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics:  Introduction  Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthese combinational networks.  Sequential logic: Flip-flops, automata, systematic hardware design  Technological foundations  Computer arithmetic: Integer addition, subtraction, multiplication and division  Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches  Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses	Computer Engineering (L03		Lecture	3	4
Admission Requirements  Basic knowledge in electrical engineering The successful completion of the labs will be honored during the evaluation of the modul examination according to the following rules:  1. Upon a passed module examination, the student is granted a bonus on the examination's maidue to the successful labs, such that the examination's marks are lifted by 0,3 or 0 respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives  Professional Competence  This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics:  Introduction  Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthese combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinin Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses	Module Responsible	Prof. Heiko Falk			
The successful completion of the labs will be honored during the evaluation of the modul examination according to the following rules:  1. Upon a passed module examination, the student is granted a bonus on the examination's mandue to the successful labs, such that the examination's marks are lifted by 0,3 or 0 respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics:  • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthese combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinine Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poconnections, busses	Admission	None			
Professional Competence  This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthese combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinine Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poconnections, busses		The successful completion of the labs wexamination according to the following rules:  1. Upon a passed module examination, the due to the successful labs, such the respectively, up to the next-better gradule.	ne student is granted a bonus of hat the examination's marks de.	on the exan are lifted	nination's mark
This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinine Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poconnections, busses	Educational Objectives	After taking part successfully, students have	reached the following learning	results	
from the assembly-level programming down to gates. The module includes the following topics:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinine Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses					
The students perceive computer systems from the architect's perspective, i.e., they identify t	Knowledge	from the assembly-level programming down in a combination in the combinational logic: Gates, Boole combinational networks in the sequential logic: Flip-flops, automata, in the computer arithmetic: Integer addition, in the Basics of computer architecture: Programming in the computer in the computer architecture: Programming in the computer in the co	to gates. The module includes to an algebra, Boolean function systematic hardware design subtraction, multiplication and amming models, MIPS single-cy DRAM, caches	the following ons, hardv division ccle archited	g topics: vare synthesis
		The students perceive computer systems	from the architect's perspect	ive, i.e., th	ey identify th

	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.
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	
-	Childrate are able to calle similar mediane alone or in a group and to present the requite accordingly
Social Competence	Students are able to solve similar problems afone or in a group and to present the results 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	
	Written exam
Examination duration 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 Environmental
	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,  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 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
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

Module M0933: F	undamentals of Materials Science			
Courses				
<b>Title</b> Fundamentals of Materials S Fundamentals of Materials S Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Typ Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 2 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	ned the following learning	results	
Professional				
Competence Knowledge	The students have acquired a fundamental kno describe this knowledge comprehensively. Fundar of atomic structure, microstructure, phase diagral properties. The students know about the key aspe identify relevant approaches for characterizing sphenomena back to the underlying physical and c	mental knowledge here n ms, phase transformation ects of characterization me specific properties. They	neans specifies, corrosion a ethods for ma	cally the issue and mechanica aterials and ca
Skills	The students are able to trace materials phenome of nature. Materials phenomena here refers to m stiffness, chemical properties such as corrosior solidification, precipitation, or melting. The stu conditions and the materials microstructure, and the material's behavior.	nechanical properties such n resistance, and to pha Idents can explain the r	h as strengtl se transform elation betw	n, ductility, an lations such a een processin
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula		Specialisation Mechanical Specialisation Biomedical Specialisation Naval Architor Specialisation Specialisation Specialisation Specialisation Specialisation, 7 semester): Specialisation, 7 semester): Specialisation Specialisation Energy and specialisation Mechanical Specialisation Biomedical Specialisation Naval Architor Specialisation, 7 semester): Specialisation,	Engineering: Engineering: tecture: Com on Mechanic ion Biomedic isation Nava on Energy an d Enviroment Engineering: Gecture: Comp on Mechanic on Biomedic isation Nava	Compulsory Compulsory pulsory cal Engineering al Architecture cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering compulsory compulsory cal Engineering al Engineering al Architecture

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	
	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7	

Course L1095: Physical	and Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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</li> <li>"Detour": Mathematics (complex e-funktion etc.)</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:         <ul> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> </ul> </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 M0598: M	lechanical Engineering: Des	ign		
Courses				
Title Embodiment Design and 3D	P-CAD (L0268)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
Mechanical Design Project I	(L0695)	Project-/problem-based Learning	3	2
Mechanical Design Project I	I (L0592)	Project-/problem-based Learning	l 3	2
Team Project Design Metho	dology (L0267)	Project-/problem-based Learning	l 2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Mechanical Engir     Mechanics     Fundamentals of Materials Science     Production Engineering			
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learn	ing 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	After passing the module, students are able to:  • independently create sketches, technical drawings and documentations e.g. using 3D CAD,  • design components based on design guidelines autonomously,  • dimension (calculate) used components,  • use methods to design and solve engineering design tasks systamtically and solution-oriented,  • apply creativity techniques in teams.			
Personal Competence				
Social Competence	After passing the module, students are able to:  • develop and evaluate solutions in groups including making and documenting decisions,  • moderate the use of scientific methods,  • present and discuss solutions and technical drawings within groups,  • reflect the own results in the work groups of the course.			
Autonomy	Students are able  • to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),  • To solve engineering design tasks systematically.			
	Independent Study Time 40, Study Time	in Lecture 140		
Credit points	6   Written exam			
Examination Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German procompulsory General Engineering Science (German procedure) General Engineering Science (German procedure) General Engineering Science (German procompulsory General Engineering Science (German procompulsory General Engineering Science (German procompulsory General Engineering Science (German procedure) General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory General Engineering Science (English procompulsory	ogram): Specialisation Mechanic ogram): Specialisation Biomedic orogram, 7 semester): Specialist orogram, 7 semester): Specialist rogram, 7 semester): Specialist Core qualification: Compulsory ogram): Specialisation Energy ogram): Specialisation Mechanic ogram): Specialisation Biomedical	cal Engineering cal Engineering cal Engineering sation Mechanic sation Biomedic ation Energy are and Enviromen cal Engineering: al Engineering:	Compulsory Compulsory Cal Engineering Cal Environmenta Cal Engineering Compulsory Compulsory 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 qualification: Compulsory
Naval Architecture: Core qualification: Compulsory

Course L0268: Embodir	ment 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</li> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</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: Mechan	ical Design Project I
	Project-/problem-based Learning
Hrs/wk	
СР	
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	ical Design Project II
Тур	Project-/problem-based Learning
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	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

Course L0267: Team Pr	roject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	
СР	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> </ul> </li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</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 M0536: F	undamentals of Fluid Mechanics			
1104410 1105501 1				
Courses				
<b>Title</b> Fundamentals of Fluid Mech Fluid Mechanics for Process	• •	<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	l	rential equations		
<b>Educational Objectives</b>	After taking part successfully, students have re	ached the following learning	results	
Professional Competence		types of flow		
Knowledge	• give an everyion for different applications of the Poynelds Transport Theorem in process			·
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				
	The students			
Social Competence	<ul> <li>are capable to gather information from subject related, professional publications and relate that 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 their 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 to present the results.</li> </ul>		to present their	
	l The students are able to			
Autonomy		,		
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Compulsory	): Specialisation Bioprocess En): Specialisation Energy and am, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation	Engineering: Enviroment ation Proces on Bioproce	Compulsory cal Engineering: ss Engineering: ss Engineering:
	Bioprocess Engineering: Core qualification: Com Energy and Environmental Engineering: Core qualification: Core qualification: Core qualification: Core qualification: Core qualification: General Engineering Science (English program) Compulsory General Engineering Science (English program) General Engineering Science (English program) Compulsory	ualification: Compulsory : Specialisation Bioprocess En i): Specialisation Energy and : Specialisation Process Engir	Enviroment neering: Con	al Engineering:

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
Process Engineering: Core qualification: Compulsory

Course L0091: Fundam	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. 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>

Course L0092: Fluid Me	echanics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	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>

Module M0610: E	lectrical Machines			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines (L0293) Electrical Machines (L0294)		Lecture Recitation Section (large)	3 2	4 2
		Recitation Section (large)	2	2
Module Responsible Admission				
Requirements	LNODE			
Recommended	Basics of mathematics, in particular complexe nu	ımbers, integrals, differenti	als	
	Basics of electrical engineering and mechanical e	engineering		
<b>Educational Objectives</b>	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Competence	Students can to draw and explain the basic princ	ciples of electric and magne	etic fields.	
Knowledge	They can describe the function of the star corresponding equations and characteristic curve parameters of the energy efficiency of the whole	es. For typically used drives	they can ex	plain the major
	Students arw able to calculate two-dimensional ecircuits with air gap. For this they apply the usua			
Skills	They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.			
Personal Competence Social Competence Autonomy	i	nance of electric machines		
Workload in Hours	  Independent Study Time 110, Study Time in Lect	uro 70		
Credit points		ure 70		
•	Written exam			
Examination duration				
and scale	120 Minuten			
	General Engineering Science (German program) Compulsory	: Specialisation Energy and	Enviroment	al Engineering:
	General Engineering Science (German progra	m): Specialisation Mechai	nical Engine	ering: Elective
	Compulsory General Engineering Science (German program,	7 semester). Specialisation	n Energy an	d Enviromental
	Engineering: Compulsory	/ Semester). Specialisatio	ii Ellergy all	u Environnentai
	General Engineering Science (German program Elective Compulsory	, 7 semester): Specialisation	on Mechanic	al Engineering:
	Electrical Engineering: Core qualification: Elective			
Assignment for the	Energy and Environmental Engineering: Core qua General Engineering Science (English program):		Enviroment	al Engineering:
Following Curricula	Compulsory	m). Charialization Machan	ical Engina	orina. Floativo
	General Engineering Science (English program Compulsory	ii). Specialisation Mechar	ııcaı Erigine	ering: Elective
	General Engineering Science (English program,	7 semester): Specialisation	n Energy an	d Enviromental
	Engineering: Compulsory General Engineering Science (English program,	7 semester): Specialisation	n Mechanic	al Engineering:
	Elective Compulsory Computational Science and Engineering: Speciali Logistics and Mobility: Specialisation Engineering Mechanical Engineering: Core qualification: Elect	Science: Elective Compuls		ompulsory
	Mechatronics: Core qualification: Compulsory	, ,		

Course L0293: Electrica	al Machines
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern
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: Electrica	al Machines
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Weitere Mitarbeiter, Dennis Kähler
Language	DE
Cycle	SoSe
	Exercises to the application of electric and magnetic fields.
Content	Excercises to the operational performance of eletric machines.
	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 M0618: Renewables and Energy Systems				
Courses				
Title Power Industry (L0316)		<b>Typ</b> Lecture	Hrs/wk 1	<b>CP</b> 1
Energy Systems and Energy	/ Industry (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	With completion of this module, the students of systems and their economic efficiency. They Furthermore, they can explain details of power or regard to subject-related contexts. The students many energy systems in general, especially for Furthermore, the students can explain the environment of the environment of the env	can explain the issues of generation, power distributes can explain these aspections renewable energy systems	occurring in tion and poots ts, which are and critica	n this context. wer trading wih re applicable to al discuss them.
Skills	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.			
Personal Competence				
Social Competence	The students are able to analyze suitable technic economical and ecological criteria under sustainal contribuition to a more sustainable power supply.	ability aspects. This allows		
Autonomy	Students can independently exploit sources , account transform it to new questions.	quire the particular knowle	dge about t	he subject area
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	!			
	Written exam			
Examination duration and scale	3 Hours written exam			
Assignment for the Following Curricula		7 semester): Specialisation 7 semester): Specialisation lification: Compulsory Specialisation Energy and 7 semester): Specialisation	n Energy ar on Mechanic Enviroment n Energy ar	nd Enviromental cal Engineering, tal Engineering:

Course L0316: Power Ir	ndustry
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
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 S	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: Renewa	ble 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 - Systemtechnik, Wirtschaftlichkeit, 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: Renewa	ble Energy
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/EN
Cycle	SoSe
Content	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.  Possible tasks in the field of renewable energies are:  Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, 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>

Module M0956: M	leasurement Technology for Me	chanical and Proces	s Engin	eers
Courses				
Measurement Technology for	ent 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)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and elec	ctrical engineering		
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence	Students are able to name the most important			
Knowledge	and Units, Uncertainty, Calibration, Static and They can outline the most important meas maesured (Electrical Quantities, Temperature, They can describe important methods of Chromatography)	uring methods for different mechanical quantities, Flow,	kinds of q Time, Frequ	uantities to b uency).
Skills	Students can select suitable measuring methods to given problems and can use refering measuremen devices in practice.  The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.			
Personal Competence	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 wit		ogies.	
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points				
Examination	Written exam			
Examination duration and scale	105 minutes			
	General Engineering Science (German programe Engineering: Compulsory General Engineering Science (German programe Compulsory General Engineering Science (German programe Compulsory General Engineering Science (German programe Compulsory General Engineering Science (English programe Engineering: Compulsory General Engineering Science (English programe Compulsory General Engineering Science (English programe Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Compulsory Core qualification: Core qualification: Compulsory Core qualification: Core qualificatio	m, 7 semester): Specialisation,  on Mechanic on Biomedic on Energy ar on Mechanic	cal Engineering cal Engineering nd Enviromenta cal Engineering	

ourse L1119: Practica	l Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	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
Literature	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufi., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmiger 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> <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> <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>

Course L1116: Measurement Technology for Mechanical and Process Engineers		
	Lecture	
Hrs/wk		
СР		
	Independent Study Time 62, Study Time in Lecture 28	
Language	Prof. Roland Harig	
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 of the class.	
_	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.	
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.	

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

Module M1275: E	nvironmental Technology			
Courses				
<b>Title</b> Practical Exercise Environm Environmental Technologie		<b>Typ</b> Practical Course Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2
	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemis	try and biology		
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learr	ning results	
Professional Competence				
Knowledge	With the completion of this modul th technology. They are able to describe the an overview of scientific disciplines involmethods.	behaviour of chemicals in the	environment. St	udents can give
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 of 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 multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.			
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 ir	Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: 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			

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	Prof. Martin Kaltschmitt	
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: Environi	
	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, Dozenten des SD V
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>
	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Title Mass Transfer (1.0101)	Module M0538: H	eat and Mass Transfer			
Heat and Mass Transfer (0.10.10.1) Heat and Mass Transfer (1.10.10.2) Heat and Mass Transfer (1.10.10.2) Recitation Section (marge)  Module Responsible Prof. Irina Smirnova  Admission Requirements  Recommended Previous Knowledge  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence  • The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e. g. heat exchanger, chemical reactors). • They are capable of distinguish and characterize different kinds of heat transfer mechanis • The students have the ability to explain the physical basis for mass transfer theories. • The students are able to set reasonable system boundaries for a given transport problem incheding the particular to explain the physical basis for mass transfer theories. • They are able to dept the analogy between heat- and mass transfer and to describe compil linked processes in detail.  • The students have the ability to explain the physical basis for mass transfer theories. • They are able to dept the analogy between heat- and mass transfer and to describe compil linked processes in detail.  • They are acquable to solve specific heat transfer problems (e.g., heated chemical reactor temperature alteration in fluids) and to calculate the corresponding energy and mass floorespectively. • They are acquable to distinguish between diffusion, convective mass transfit on and mass transfer the particular the course of the students are capable to calculate the corresponding heart flows. • Using dimensionless quantities, the students can execute scaling up of technical processes. • They can use this knowledge of the description and design of apparatus (e.g. extraction column recitication column). • In this context, the students are capable to choose and design fundamental types of heat a mass exchanger for a specific application considering their advantages and disadvantages and disadvantages and disadvantages and disadvan	Courses				
Module Responsible   Admission   Name   Basic knowledge   Basic knowledge   Basic knowledge   Basic knowledge   Professional   Competence	Heat and Mass Transfer (L0: Heat and Mass Transfer (L0:	102)	Lecture Recitation Section (small)	2	2 2
Recommended Previous Knowledge  Basic knowledge: Technical Thermodynamics  Recommended Previous Knowledge  After taking part successfully, students have reached the following learning results  Professional Competence  **The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e. g. heat exchanger, chemical reactors).  They are capable of distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal readiation.  They are capable of distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal readiation.  They are capable to distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal readiation.  They are capable to depict the analogy between heat- and mass transfer and tendent of the part of the part of the part of the depict the analogy between heat- and mass transfer and to describe compliance of the part of	·				_
Recommended Previous Knowledge: Technical Thermodynamics  Professional Competence  **The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g., heat exchanger, chemical reactors).  **The students are capable of distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal readation.  **The students have the ability to explain the physical basis for mass transfer in detail and describe assort snafer qualitative and quantitative by using suitable mass transfer theories.  **They are able to depict the analogy between heat- and mass transfer and thermal readation.  **They are able to depict the analogy between heat- and mass transfer and to describe compil linked processes in detail.  **They are able to solve specific heat transfer problems (e.g., heated chemical reactor temperature alteration in fluids) and to calculate the corresponding energy and mass find respectively.  **They are capable to solve specific heat transfer problems (e.g., heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.  **Skills**  **T					
Recommended Previous Knowledge  Educational Objectives  Professional Competence  **The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g. heat exchanger, chemical reactors).  **They are capable of distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal radiation.  **Knowledge**  **Knowledge**  **They are capable of distinguish and characterize different kinds of heat transfer mechanism namely heat conduction, heat transfer and thermal radiation.  **Knowledge**  **They are capable of distinguish with and quantitative by using suitable mass transfer in detail and escite mass transfer under the processes in detail.  **They are able to depict the analogy between heat- and mass transfer and to describe complimated in the processes of the processes in detail.  **They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.  **Using dimensionless quantities, the students can execute scaling up of technical processes apparatus.  **They are able to distinguish between diffusion, convective mass transfin and mass transfer problems (e.g. heated chemical processes apparatus.  **They are able to distinguish between diffusion, convective mass transfin and mass transfer problems (e.g. heated chemical processes apparatus.  **They are able to distinguish between diffusion, convective mass transfin and mass transfer and to distinguish between diffusion, convective mass transfin and mass transfer and to distinguish between diffusion, convective mass transfer and to processes apparatus.  **They are able to distinguish between diffusion, convective mass transfer and advantage apparatus (e.g. extraction column restriction).  **In this context, the students are capable to choose and design fundamental types of heat and assess exchanger for a specific application considering their advantages and disa	Requirements				
Professional Competence  **The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g., heat exchanger, chemical reactors).  **They are capable of distinguish and characterize different kinds of heat transfer mechanism and describe mass transfer qualitative and quantitative by using suitable mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer theories.  **They are able to depict the analogy between heat- and mass transfer and to describe completinked processes in detail.  **The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding energy and mass for respectively.  **They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.  **Using dimensionless quantities, the students can execute scaling up of technical processes apparatus.  **Skills**  **		Basic knowledge: Technical Thermodyna	amics		
**The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e. g. heat exchanger, chemical reactors).  **The vare capable of distinguish and characterize different kinds of heat transfer mechanisr namely heat conduction, heat transfer and thermal radiation.  **The students have the ability to explain the physical basis for mass transfer in detail and describe mass transfer students have the ability to explain the physical basis for mass transfer and describe mass transfer students have the ability to explain the physical basis for mass transfer in detail and describe mass transfer students have the ability to explain the physical basis for mass transfer in detail and describe mass transfer and to describe complimited in the physical basis for mass transfer and to describe complimited in the physical basis for mass transfer and to describe complimited in the physical basis for mass transfer and to describe complimited in the physical basis for mass transfer in detail and describe mass transfer and to describe complimited in the physical basis for mass transfer in detail and describe mass transfer and to describe complimited in the physical basis for mass transfer and to describe complimited in the physical basis for mass transfer in detail and describe mass framsfer and to describe complimited in the physical processes and the physical processes and the physical processes and the physical processes and the physical processes and the physical processes in proceduration and design of apparatus (e.g. extraction column).  **Skills**  **Skills**  **In the students are capable to be treasonable to choose and design fundamental types of heat an mass exchanger for a specific application considering their advantages and disadvantage respectively.  **In didition, they can calculate both, steady-state and non-steady-state processes in procedurable apparatus.  **The students are capable to work on subject-specific challenges in teams and to present the results orally	<b>Educational Objectives</b>	After taking part successfully, students h	nave reached the following learning	results	
Fresonal Competence  Social Competence  For Social Competence  Social Competence  For Social Competence  Autonomy  The students are able to find and evaluate necessary information from suitable sources  The students are able to concert technical processes.  The students are able to concert technical processes in procedure apparatus.  The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding energy and mass flor respectively.  They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.  Using dimensionless quantities, the students can execute scaling up of technical processes.  They are able to distinguish between diffusion, convective mass transfits apparatus.  They are able to distinguish between diffusion convective mass transfits apparatus.  They are able to distinguish between diffusion convective mass transfits apparatus.  They are able to distinguish between diffusion convective mass transfits apparatus.  They are able to distinguish between diffusion convective mass transfits apparatus.  They are able to distinguish between diffusion convective mass transfit in a distinct on the description and design fundamental types of heat a mass exchanger for a specific application considering their advantages and disadvantage in a disadvantage and disad					
using the gained knowledge and to balance the corresponding energy and mass florespectively.  They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.  Using dimensionless quantities, the students can execute scaling up of technical processes apparatus.  They are able to distinguish between diffusion, convective mass transition and mass transfer They can use this knowledge for the description and design of apparatus (e.g. extraction column).  In this context, the students are capable to choose and design fundamental types of heat an mass exchanger for a specific application considering their advantages and disadvantage respectively.  In addition, they can calculate both, steady-state and non-steady-state processes in procedur apparatus.  The students are capable to connect their knowledge obtained in this course with knowlegde other courses (in particular the courses thermodynamics, fluid mechanics and chemical proce engineering) to solve concrete technical problems.  Personal Competence  **The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors and other students.  **The students are able to find and evaluate necessary information from suitable sources they are able to prove their level of knowledge during the course with accompanying procedured continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes.  **Workload in Hours**  Workload in Hours*    Independent Study Time 124, Study Time in Lecture 56	Knowledge	<ul> <li>procedural apparatus (e. g. heat e</li> <li>They are capable of distinguish namely heat conduction, heat trail</li> <li>The students have the ability to describe mass transfer qualitative</li> <li>They are able to depict the analog</li> </ul>	exchanger, chemical reactors). and characterize different kinds of nsfer and thermal radiation. explain the physical basis for mae and quantitative by using suitable	heat trans ss transfer mass transf	fer mechanism in detail and t er theories.
The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors and other students.      The students are able to find and evaluate necessary information from suitable sources     They are able to prove their level of knowledge during the course with accompanying procedur continuously (clicker-system, exam-like assignments) and on this basis they can control the 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	Skills	using the gained knowledge a respectively.  They are capable to solve spectemperature alteration in fluids) a  Using dimensionless quantities, tapparatus.  They are able to distinguish betwoe They can use this knowledge for trectification column).  In this context, the students are mass exchanger for a specific a respectively.  In addition, they can calculate be apparatus.  The students are capable to conrother courses (In particular the context).	cific heat transfer problems (e.g. and to calculate the corresponding has been diffusion, convective mass transfer description and design of apparation application considering their advantage of the steady-state and non-steady-states their knowledge obtained in this ourses thermodynamics, fluid mechanics	heated che eat flows. Ip of technic ansition and attus (e.g. extended attus) the control of the	emical reactor cal processes I mass transfe traction colum pes of heat ar disadvantage es in procedur th knowlegde
**Social Competence**  **The students are able to find and evaluate necessary information from suitable sources  **They are able to prove their level of knowledge during the course with accompanying procedu continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes.  **Workload in Hours**  **Morkload in Hours**  **Independent Study Time 124, Study Time in Lecture 56*  **Credit points**  **Examination**  **Written exam**  **Examination duration and scale**  **120 minutes; theoretical questions and calculations**	Personal Competence				
Autonomy  * They are able to prove their level of knowledge during the course with accompanying procedur continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes.  **Workload in Hours**    Independent Study Time 124, Study Time in Lecture 56   Credit points 6   Examination   Written exam	Social Competence			n teams and	l to present th
Credit points 6 Examination Written exam  Examination duration and scale 120 minutes; theoretical questions and calculations	Autonomy	<ul> <li>They are able to prove their level continuously (clicker-system, exa</li> </ul>	of knowledge during the course wi	th accompa	nying procedu
Examination Written exam  Examination duration and scale 120 minutes; theoretical questions and calculations	Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Examination duration and scale 120 minutes; theoretical questions and calculations	Credit points	6			
and scale	Examination	Written exam			
anu scale		120 minutes; theoretical questions and o	calculations		
	and scale				

Assignment for the Following Curricula	
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Course L0101: Heat and Mass Transfer		
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	1. Heat transfer  Introduction, one-dimensional heat conduction  Convective heat transfer  Multidimensional heat conduction  Non-steady heat conduction  Thermal radiation  Mass transfer  one-way diffusion, equimolar countercurrent diffusion  boundary layer theory, non-steady mass transfer  Heat and mass transfer single particle/ fixed bed  Mass transfer and chemical reactions	
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	

Course L1868: Heat an	ourse 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		

Module M0546: T	hermal Separation Processes			
Title Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141)		Typ Lecture Recitation Section (small) Recitation Section (large) Practical Course	Hrs/wk 2 2 1	<b>CP</b> 2 2 1 1
Separation Processes (L115	· •	Practical Course	1	1
Module Responsible Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can distinguish and describe different types of separation processes such a distillation, extraction, and adsorption</li> <li>The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems</li> <li>They have good knowledge of designing methods for separation processes and devices</li> </ul>			ng a separation energy saving
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a give 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 process an 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 based o the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties from 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 of the experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use together for the solution of technical problems. Other lectures such as thermodynamics, fluimechanics and chemical engineering.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>The students can work technical assignments in small groups and present the combined resin the tutorial</li> <li>The students are able to carry out practical lab work in small groups and organize a function division of labor between them. They are able to discuss their results and to document the scientifically in a report.</li> </ul>		ize a functiona	
Autonomy	<ul> <li>The students are capable to obtain the needed information from suitable sources by themselve and assess their quality</li> <li>The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
	Written exam			
Examination duration and scale	1170 minutes, theoretical offestions and calculation	ns		
	General Engineering Science (German program Compulsory General Engineering Science (German program,			

Assignment for the Following Curricula	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: 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 Environmental Engineering: Compulsory Process Engineering: Core qualification: Compulsory
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Course 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 Technischen Chemie</li> </ul>

Course L0119: Thermal	Separation Processes
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> The students work on tasks in small groups and present their results in front of all students.
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>

Course 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>

Course L1159: Separation Processes		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.	
Lecturer	Prof. Irina Smirnova	
Language	DE/EN	
Cycle	WiSe	
Content	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.  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 on their own reports and level of scientific writing so they can increase their capabilities in this area.  Topics of the practical course:  Introduction in the thermal process engineering and to the main features of separation processes  Simple equilibrium processes, several steps processes  Distillation of binary mixtures, enthalpy-concentration diagrams  Extractive and azeotrope distillation, water vapor distillation, stepwise distillation  Extraction: separation ternary systems, ternary diagram  Multiphase separation including complex mixtures  Designing of separation devices without discrete stages  Drying  Chromatographic separation processes  Membrane separation  Energy demand of separation processes  Advance overview of separation processes  Selection of separation processes	
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 M0639: G	as and Steam Power Plants			
Courses				
Title Gas and Steam Power Plants (L0206) Gas and Steam Power Plants (L0210)		Typ Lecture Recitation Section (large)	Hrs/wk 3 1	<b>CP</b> 5 1
Module Responsible	<u> </u>	recitation Section (large)		-
Admission				
Requirements	None			
Recommended Previous Knowledge	I ♠ "Hoat Trancfor"			
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence Knowledge	The students can evaluate the development of the electricity demand and the energy conversion 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			
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels and based on well-founded knowledge on the function and construction of gas and steam power plants, to identify basic associations in the production of heat and electricity, so as to develop conceptual solutions. Through analysis of the problem and exposure to the inherent interplay between heat and power generation the students are endowed with the capability and methodology to develop realistic optimal concepts for the generation of electricity and the production of heat. From the technical basics the students become the ability to follow better the deliberations on the electricity mix composition 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 suite EBSILON Professional <sup>TM</sup> . With this tool small practical tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.  The students are able to do simplified calculations on turbomachinery either as part of a plant, as single			
	component or at stage level.			
Personal Competence	! !			
Social Competence	An excursion within the framework of the lectu students get in this manner direct contact with a obtain first-hand experience with a power plar between technical and political issues.	modern power plant in th	is region. T	ne students wil
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 power plants and calculate selected quantities and characteristic curves.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points				
	Written exam			
Examination duration and scale	ivillen examination of 170 min			
	General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core qual Energy Systems: Technical Complementary Cours	7 semester): Specialisation ification: Compulsory e Core Studies: Elective Core semester): Specialisation semester): Specialisation	on Mechanic ompulsory n Energy an	al Engineering d Enviromenta

Course L0206: Gas and	Steam Power Plants
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
	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 plant • Construction materials for power plants • Location of power plants • Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues:  • Energy balance of a turbomachine • Theory of turbine and compressor stage • Equal and positive pressure blading • Flow losses • Characteristic numbers • Axial and radial design • Design features • Hydraulic turbomachines
	<ul> <li>Pump and water turbine designs</li> <li>Design examples of reciprocating engines and turbomachinery</li> <li>Steam power plants</li> <li>Gas turbine systems.</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>

Course L0210: Gas and	Steam Power Plants
	Recitation Section (large)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plants is 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  • 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  • Coolong systems  • Flue gas cleaning  • Operation characteristics of the power plant  • Construction materials  • Location of power plants  The environmental impact of acidification, fine particulate or CO <sub>2</sub> emissions and the resulting climatic effects are a special focus of the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discussed and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.  Within the framework of the exercise the students learn the use of the specialised software suite Bessilon Professional. **Mith this tool small tasks are solved on the PC, to highlight aspects of the design and development of p
Literature	<ul> <li>Skripte</li> <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>

Courses				
Title	(I OCE 4)	Тур	Hrs/wk	CP
Introduction to Control Systems Introduction to Control Systems		Lecture Recitation Section (small	2 ) 2	4 2
Module Responsible		•		
Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and syste	ms in time and frequency domain, Lap	ace transforn	า
Educational Objectives	After taking part successfully, stude	ents have reached the following learnin	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	Ctudente can work in small around	to injustive only a tochnical problems, and	ave arim anta	lly validata tha
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate the controller designs  Students can obtain information from provided sources (lecture notes, software documentation)			
Autonomy	experiment guides) and use it wher They can assess their knowledge in	n solving given problems.  weekly on-line tests and thereby contr	ol their learni	ng progress.
Autonomy				
Workload in Hours	Independent Study Time 124, Study	V Time in Lecture 56		
Credit points		,		
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (Ge Compulsory	erman program, 7 semester): Speci	alisation Con	nputer Scienc
	General Engineering Science (Ger	man program, 7 semester): Specialisa	tion Bioproce	ss Engineerin
	Compulsory General Engineering Science (Ge	erman program, 7 semester): Specia	alisation Nav	al Architectur
	Compulsory	erman program, 7 semester): Spec		
	Compulsory			J
	General Engineering Science (Ger Compulsory	man program, 7 semester): Specialis	ation Electric	cal Engineerin
	General Engineering Science (Gen	man program, 7 semester): Specialisa	tion Biomedi	cal Engineerin
	Compulsory General Engineering Science (Gerr Engineering: Compulsory	nan program, 7 semester): Specialisat	on Energy ar	nd Enviroment
		rman program, 7 semester): Special	isation Proce	ss Engineerin

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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	ction to Control Systems
	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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 M0670: P	article Technology and Solids Pro	ocess Engineering		
Courses				
Title Particle Technology I (L0434) Particle Technology I (L0445) Particle Technology I (L0446)	5)	Typ Lecture Recitation Section (small) Practical Course	Hrs/wk 2 1 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous Knowledge	keine			
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence	After successful completion of the module stude	nto are able to		
Knowledge	<ul> <li>After successful completion of the module students are able to</li> <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	Students are able to			
Personal Competence				
Social Competence	The students are able to discuss scientific topics develop solutions for technical-scientific issues in	n a group.		
Autonomy	Students are able to analyze and solve questions	s regarding solid particles in	dependently	/.
Workload in Hours	Independent Study Time 110, Study Time in Lect	ture 70		
Credit points	6			
Examination				
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory Bioprocess Engineering: Core qualification: Comp Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program, Engineering: Compulsory Process Engineering: Core qualification: Compulsory	n, 7 semester): Specialisation oulsory alification: Compulsory n, 7 semester): Specialisation 7 semester): Specialisation	on Bioproce n Energy ar ation Proces on Bioproce	ss Engineering: d Enviromental ss Engineering: ss Engineering:

Course L0434: Particle	Technology 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>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	ırse L0435: Particle Technology I	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	Tochnology
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 M1274: E	nvironmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment	•	Lecture	2	2 1
Environmental Assessment		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements	INONE			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry and	biology		
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence	 	ecquire in-denth knowledg	e of imports	nt cause effect
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 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.			
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 EcoInvent. 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 and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business context and are able to judge results of other publications.			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	e 42		
Credit points				
	Written exam			
Examination duration and scale	I I hour wriften exam			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory Process Engineering: Core qualification: Elective Compulsory Process Engineering: Core qualification: Elective Compulsory			

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
	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	
Content	Life cycle concept: Life cycle assessment (LCA)	
	<b>Sustainability</b> : Comprehensive product system assessment , SEE-Balance	
	<b>Management</b> : Environmental and Sustainability management (EMAS)	
	Complex systems: MCDA and scenario method	
	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich	
Literature	GmbH)	

Course L1054: Environ	mental 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, Dr. Anne Rödl
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: II	nformatics for Process Engine	ers		
Courses				
Title Informatics for Process Engi Informatics for Process Engi Numeric and Matlab (L0125	ineers (L0837)	<b>Typ</b> Lecture Recitation Section (small) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 2 2 2 2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements				
Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
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 solutions toge	ther in small groups.		
Autonomy	Students are able to assess acquired skills by applying it in practice.			
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points				
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and 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 General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory			

Course L0836: Informatics 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  Objects, classes Methods, properties Inheritance Basics of the language Java Sample application: Simulation of an electricity network 2D graphics Events and Controls	
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/	

Тур	Recitation Section (small)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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.
	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		
СР		
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):  1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004  2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007  3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de  4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005	

Module M0539: P	rocess and Plant Engineering I			
Courses				
Title Process and Plant Engineeri Process and Plant Engineeri Process and Plant Engineeri	ng I (L0096)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Georg Fieg			
Admission Requirements	None			
Recommended Previous Knowledge	unit operation of thermal an dmechanical separation processes chemical reactor eingineering			
Educational Objectives Professional Competence	After taking part successfully, students have r students can:	eached the following learning	results	
Knowledge	classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilliation problems explain pfd-diagrams			
Skills	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		nodels	
Personal Competence Social Competence Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			_
Examination	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
	General Engineering Science (German programulsory) General Engineering Science (German programulsory) General Engineering Science (German programulsory) General Engineering Science (German programulsory) Bioprocess Engineering: Core qualification: Core General Engineering Science (English programulsory) General Engineering Science (English programulsory) General Engineering Science (English programulsory) General Engineering Science (English programulsory) General Engineering Science (English programulsory) Frocess Engineering: Core qualification: Comp	am, 7 semester): Specialisation  im, 7 semester): Specialisation  impulsory  ram, 7 semester): Specialisation  impulsory  ram, 7 semester): Specialisation  m, 7 semester): Specialisation	on Bioproces  n Energy an  ation Proces  on Bioproces	ss Engineering: d Enviromental ss Engineering ss Engineering

Course 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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg	
Language	DE	

1. Introduction Structure and operation of production plants Operations business process Motivation and largets 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 recordilation and data validation 3. Process Synthesis 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  5.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech., 72(2000)Nr. 10, S. 1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technis. Prozesse und Produkte, Band 2, Neue Technologien, S. Auflage, Wiley-VCH GmbH6Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proce., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994), S. 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Selth, Chemie eine reife Industria oder weiterhin Innovationsmotor, Universitätsbuchhandfung Blazek und Bergamann, Frankfurt, 2000 J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 Literature T.E. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, O. Grahh, Vorfesungsmanuskript, Prozess- und Anlagentechnik, TU Hamburg-Harburg D. Hairston, ChemIngTech. 66(1994), S. 309 J. M	Structure and operation of production plants Operational business process Technical process design Metivation and targets of process development Life cycle of production plants  2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Strategies of process synthesis Multidimensional regression Data reconcilitation 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 sarfety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation  S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679  H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74  Behr, W. Ebbers, N. Wiese, ChemIngTech., 72(2000)Mr. 10, S. 1157  E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997  M. H. Bauer, J. Stichimair, ChemIngTech., 68(1996), Nr. 8, 911-916  R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik, Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH6Co. KGaA, Weinheim, 2004  J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988  G. Fieg, Irc. Chem. Proc., 5(1979), S.15-19  G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994), S, 301-306  G. Fieg, Heat and Mass Transfer 32(1996), S. 205-2213  G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133  U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchbandlung Blazek und Bergamann, Frankfurt, 2000  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. Grunn, Vorlesungsmanuskript, Prozess- und Anlagentechnik, TU Hamburg-Harburg  D	Cycle	SoSe
H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, S. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 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	H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 Literature T.F. Edgar, D.M. Himmeiblau, 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, ChemIngTech. 61 (1989), Nr. 2, S. 104-112 G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112 G. Kaibel, ChemEng. Technol., 10(1987), Nr. 2, S. 92-98 H.J. Lang, Chem. Eng. 54(10),117, 1947	Content	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
G. Kaibel, Dissertation, TU München, 1987	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98  H.J. Lang, Chem. Eng. 54(10),117, 1947	Literature	<ul> <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, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000</li> <li>J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991</li> <li>T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001</li> <li>G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg</li> <li>D. Hairston, Chemical Engineering, October 2001, S. 31-37</li> <li>J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002</li> <li>J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511</li> <li>K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824</li> <li>S. Meier, G. Kaibel, ChemIngTech. 66(1994), S. 309</li> <li>P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534</li> <li>G. Kaibel, Dissertation, TU München, 1987</li> </ul>

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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course 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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to  • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management  • explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects  • describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing  • explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance  • state basics from accounting and costing and selected controlling methods.			
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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence	i			
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>		rite a coherent	
	l Students are able to			
Autonomy		emselves		
Workload in House	Independent Study Time 110, Study Time in Lectur	o 70		
Credit points		C . C		
•	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

Assignment for the

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **Specialization Computer Science**

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

Modulo MOES1. D	Signato Algobraic Structur			
Module M0561: D	iscrete Algebraic Structur	es		
Courses				
Title		Тур	Hrs/wk	CP
Discrete Algebraic Structure Discrete Algebraic Structure		Lecture Recitation Section (small)	2	3 3
		Recitation Section (Smail)	2	3
	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics from High School.			
<b>Educational Objectives</b>	After taking part successfully, student	s have reached 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 from specific standard books and to associate the acquired knowledge to other classes.			
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	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 Technomathematics: Specialisation I. Mathematics: Elective Compulsory			

Course L0164: Discrete	ourse L0164: Discrete Algebraic Structures	
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	
Cycle	WiSe	
Content		
Literature		

Course L0165: Discrete	urse L0165: Discrete Algebraic Structures	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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: C	computer Engineering			
Courses				
Title Computer Engineering (L03 Computer Engineering (L03		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
•	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	The successful completion of the labs will examination according to the following rules:  1. Upon a passed module examination, the due to the successful labs, such tha respectively, up to the next-better grade 2. The improvement of the grade 5,0 up to	student is granted a bonus of t the examination's marks	on the exami are lifted b	nation's marks
<b>Educational Objectives</b>	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	This module deals with the foundations of the from the assembly-level programming down to  Introduction Combinational logic: Gates, Boolean combinational networks Sequential logic: Flip-flops, automata, systematical foundations Computer arithmetic: Integer addition, subspaces of computer architecture: Program Memories: Memory hierarchies, SRAM, Die Input/output: I/O from the perspective connections, busses	gates. The module includes t algebra, Boolean function stematic hardware design subtraction, multiplication and aming models, MIPS single-cy RAM, caches of the CPU, principles of p	he following ons, hardwa division role architect assing data	topics:  are synthesis,  ure, pipelining  point-to-point
Skills	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.  Solution 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 shat 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 proposite feasible options.		n analyze, how we and simple ction layers of ordependencies lar, they shal tric abstraction o evaluate the	
Personal Competence				
	Students are able to solve similar problems alor	ne or in a group and to prese	nt the results	accordingly.
Autonomy	Students are able to acquire new knowledge f with other classes.	rom specific literature and t	o associate i	this knowledge
Workload in Hours	I Independent Study Time 124, Study Time in Lec	cture 56		
Credit points				
	Written exam			
Examination duration and scale	190 minutes contents of course and lans			
	General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	ram, 7 semester): Specialisation,	sation Comon Bioproces sation Nava lisation Civition Electrica	s Engineering I Architecture I Engineering al Engineering

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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** 

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 Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

[239]

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	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 Objectorionted Programmin	g, Algorithms and Data Structures (L01		<b>Typ</b> Lecture	Hrs/wk 4	<b>CP</b> 4
-	g, Algorithms and Data Structures (LOI g, Algorithms and Data Structures (LOI	•	Recitation Section (small)	1	2
	Prof. Rolf-Rainer Grigat				
Admission Requirements	None				
_	Lecture Prozedurale Programmieru	ing or equivalent	proficiency in imperative	programmi	ng
Recommended Previous Knowledge	Mandatory prerequisite for this lec similar). You should be familiar wit while, procedure calls or function programs and therefore should be we will immediately start with the above. This remark is especially important	th simple data ty n calls, pointers, proficient with e introduction of c	ypes (integer, double, cha and you should have u editor, compiler, linker an objects and we will not re	ar), arrays, insed all thosed all thosed all thosed all thosed all thosed are depended as the based are depended as the ba	f-then-else, fose in your ov In this lectu Isics mention
	curriculum. They are prerequisites IIW include those prerequisites in the contract of the cont				
Educational Objectives	After taking part successfully, stud-	ents have reache	ed the following learning	results	
Professional		<u> </u>			
Competence	Students can explain the essential reference to existing class libraries			f a class ar	chitecture wi
Knowledge	Students can describe fundamenta of important algorithms for sorting		of discrete mathematics	and assess	the complex
Skills	<ul> <li>Students are able to</li> <li>Design software using given</li> <li>Carry out software developn</li> <li>Sort and search for data efficence</li> <li>Assess the complexity of algorithms</li> </ul>	nent and tests us ciently			
Personal Competence	Students can work in teams and co	ommunicate in fo	irums.		
Autonomy	Students are able to solve program Google Test independently and ove			n using SVN	Repository a
Workload in Hours	Independent Study Time 110, Stud	ly Time in Lectur	e 70		
Credit points					
Examination	Written exam				
Examination duration and scale	60 Minutes, Content of Lecture, exe	ercises and mate	erial in StudIP		
Assignment for the Following Curricula	General Engineering Science (Gern General Engineering Science (General Engineering Science (General Engineering: Core qualification of the Core and Engineering Science (Englished Engineering Science (Engineering Engineering Science (Engineering Engineering Science (Engineering Engineering Science Engineering Engineering Science and Engineering Engineer	erman program on: Compulsory cation: Compulso ish program): Sp nglish program,	ory ecialisation Computer Sci 7 semester): Specialis	sation Com	iputer Scienc
	Computational Science and Engine Logistics and Mobility: Specialisation			ory	

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

<u></u>		
Courses		
Title	Typ Hrs/wk CP	
Signals and Systems (L0432		
Signals and Systems (L0433	Recitation Section (small) 2 2	
Module Responsible		
Admission Requirements	None	
	Mathematics 1-3	
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Four series, Fourier transform, Laplace transform) is useful but not required.	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional		
Competence		
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 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.	
<b>Personal Competence</b>		
Social Competence	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	
Credit points	6	
Examination		
Examination duration and scale	90 min	
	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 Civil- and Environmental 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, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation 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 Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Micraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Comp	
Assignment for the	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: 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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals	and 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 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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0852: G	Granh Ti	heory an	d Ontim	nizatio	n				
Module Moose: C	ларіі і	neory and	и Орин	iizacio	•				
Courses									
<b>Title</b> Graph Theory and Optimization (L1046) Graph Theory and Optimization (L1047)				<b>Typ</b> Lecture Recitation Sec	ction (small)	Hrs/wk 2 2	<b>CP</b> 3 3		
Module Responsible	Prof. Anus	sch Taraz							
Admission Requirements	None								
Recommended Previous Knowledge	• Dis	crete Algebra thematics I	aic Structure	es					
Educational Objectives	After takir	ng part succe	ssfully, stu	dents hav	e reache	d the followi	ng learning	results	
Professional Competence									
Knowledge	exp • • Stu illu:	olain them us	ing appropo discuss log e connectio	riate exar ical conr ons with th	mples. nections ne help o	between the fexamples.			ney are able to are capable of
Skills	<ul> <li>Students can model problems in Graph Theory and Optimization 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	• Stu lan • In (	guage. doing so, the	ey can com	municate	new cor	ncepts accor	ding to the	needs of th	cs as a common eir cooperating tanding of their
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	Independe	ent Study Tim	ne 124, Stu	dy Time i	n Lecture	56			
Credit points	6			-					
Examination	Written ex	xam							
Examination duration and scale	1120 min								
	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 Technomathematics: Specialisation I. Mathematics: Elective Compulsory								

Course L1046: Graph Theory and Optimization					
Тур	ecture				
Hrs/wk	2				
СР	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Lecturer	Prof. Anusch Taraz				
Language	DE				
Cycle	SoSe				
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					
СР	3				
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28				
Lecturer	of. Anusch Taraz				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0727: S	tochastics				
Courses					
Title Stochastics (L0777) Stochastics (L0778)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 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 (combinatorics</li><li>Propositional logic</li></ul>	)			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning	results		
Professional Competence					
Knowledge Skills	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.  Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are good enough in various application contexts, i.e., students can derive estimators and judge whether they are applicable or reliable.				
Personal Competence					
Social Competence	- Students are able to work together (e.g. on thei teams (i.e., teams from different study programs results appropriately (e.g. during exercise class).				
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 can put their knowledge in relation to the contents of other lectures.</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 124, Study Time in Lectur	e 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
	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 Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory				

Course L0777: Stochas	tics				
Тур	Lecture				
Hrs/wk	Hrs/wk 2				
СР	1				
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28				
Lecturer	Dr. Francisco Javier Hoecker-Escuti, Dr. Christian Seifert				
Language	EN .				
Cycle	SoSe				
Content	Foundations of probability theory  Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments  Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen  Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues  Detection & estimation  Detectors Estimation rules and procedures Hypothesis and distribution tests Stochastic regression				
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 2010</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: 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			

Module M0624: A	automata Theory and Formal La	nguages						
Courses								
Title Automata Theory and Form Automata Theory and Form		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2				
Module Responsible	Prof. Tobias Knopp							
Admission Requirements	None							
•	Participating students should be able to							
	- specify algorithms for simple data structures (such as, e.g., arrays) to solve computational problems							
Recommended Previous Knowledge	- apply propositional logic and predicate logic for specifying and understanding mathematical proofs							
	- apply the knowledge and skills taught in the	module Discrete Algebraic Str	uctures					
Educational Objectives	After taking part successfully, students have r	eached the following learning	results					
Professional Competence								
Knowledge	Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problems. Students can show correspondences to Boolean 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 nondeterministic finite automata and pushdown automata to Turing machines. Students can name 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.							
Skills	Students can apply propositional logic as well as predicate logic resolution to a given set of formulas Students analyze application problems in order to derive propositional logic, predicate logic, of 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 decision problems to specific formulas. Students can also transform nondeterministic automata into deterministic ones, or derive grammars from automata and vice versa. They can show how parser work, and they can apply algorithms for the language emptiness problem in case of infinite words.							
Personal Competence	! !							
Social Competence	! !							
Autonomy		actura F.C						
Workload in Hours Credit points	Independent Study Time 124, Study Time in L	ecture 50						
<u> </u>	Written exam							
Examination duration								
and scale	90 min 							
Assignment for the Following Curricula	General Engineering Science (German prograr General Engineering Science (German prograr Compulsory Computer Science: Core qualification: Compuls General Engineering Science (English program General Engineering Science (English program Compulsory Computational Science and Engineering: Core Computational Science and Engineering: Core Technomathematics: Specialisation II. Informa	n, 7 semester): Specialisation sory (): Specialisation Computer Sci n, 7 semester): Specialisation qualification: Compulsory qualification: Compulsory	Computer Si	cience: Elective ulsory				

Тур	Lecture
Hrs/wk	2
СР	4
<b>Workload in Hours</b>	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Tobias Knopp
Language	EN
Cycle	SoSe
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</li> <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:         <ul> <li>Correctness of the minimization procedure, equivalence classes of strings induced by automa</li> <li>Pumping Lemma for regular languages: provision of a tool which, in some cases, can be used to show that a finite automaton princip 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> </ul> </li> <li>Pushdown automata and context-free grammars:         <ul> <li>Definition of pushdown automata, definition of context-free grammars, derivations, parse transformation of pushdown automata to context-free grammars and back)</li> <li>Chomsky normal form</li> <li>CYK algorithm for deciding the word problem for context-free grammrs</li> <li>Deterministic pushdown automata</li> <li>Deterministic pushdown automata</li> <li>Deterministic pushdown automata</li> </ul> </li> <li>Deterministic or sondeterministic pushdown automata:         <ul> <li>Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler</li> <li>Regular 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 Theory and Formal Languages					
Тур	Recitation Section (small)				
Hrs/wk					
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				

mbedded Systems					
		Hrs/wk	<b>CP</b> 4		
)	Recitation Section (small)	1	2		
Prof. Heiko Falk					
None					
Computer Engineering					
After taking part successfully, students have re	eached the following learning	results			
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).					
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 of 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.					
Students are able to solve similar problems alone or in a group and to present the results accordingly.					
Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.					
Independent Study Time 124, Study Time in Lecture 56					
6					
Written exam					
90 minutes, contents of course and labs					
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 Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective 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 Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory					
	Prof. Heiko Falk  None  Computer Engineering  After taking part successfully, students have re  Embedded systems can be defined as info products. This course teaches the foundati introduction into these systems (notions, con (models of computation, hierarchical automs specification of real-time applications, translati Another part covers the hardware of embedde dapable communication hardware, embedded logic and actuators. The course also feature middleware and real-time scheduling. Final hardware/software co-design (hardware/so specifications, energy-efficient realizations, con After having attended the course, students students shall realize which relevant parts of functional embedded systems. In particular, computations and feasible techniques for systemas of embedded system design specific risk Students are able to solve similar problems alough to the classes.  Independent Study Time 124, Study Time in Lefe Written exam  90 minutes, contents of course and labs  General Engineering Science (German program Computer Science: Specialisation Computer and Electrical Engineering: Core qualification: Elect Aircraft Systems Engineering: Specialisation Active Computational Science and Engineering: Core Computational Science and Engineering:	Typ Lecture Recitation Section (small)  Prof. Heiko Falk  None  Computer Engineering  After taking part successfully, students have reached the following learning  Embedded systems can be defined as information processing systems products. This course teaches the foundations of such systems. In pintroduction into these systems (notions, common characteristics) and the (models of computation, hierarchical automata, specification of distribut specification of real-time applications, translations between different models another part covers the hardware of embedded systems: Sonsors, A/D an capable communication hardware, embedded processors, memories, energy logic and actuators. The course also features an introduction into reamiddleware and real-time scheduling. Finally, the implementation of hardware/software co-design (hardware/software partitioning, high-specifications, energy-efficient realizations, compilers for embedded process After having attended the course, students shall be able to realize simple students shall realize which relevant parts of technological competences functional embedded systems. In particular, they shall be able to cor computations and feasible techniques for system-level design. They shall areas of embedded system design specific risks exist.  Students are able to solve similar problems alone or in a group and to prese Students are able to acquire new knowledge from specific literature and twith other classes.  Independent Study Time 124, Study Time in Lecture 56  Written exam  90 minutes, contents of course and labs  General Engineering Science (German program, 7 semester): Specialisation Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elect Electrical Engineering: Core qualification: Elective Compulsory  Computer Science and Engineering: Core qualification: Compulsory  Computational Science and Engineering: Core qualification: Compulsory  Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory	Typ Lecture 3 Recitation Section (small) 1  Prof. Heiko Falk  None  Computer Engineering  After taking part successfully, students have reached the following learning results  Embedded systems can be defined as information processing systems embedded products. This course teaches the foundations of such systems. In particular, it introduction into these systems (notions, common characteristics) and their specifica (models of computation, hierarchical automata, specification of distributed system specification of real-time applications, translations between different models).  Another part covers the hardware of embedded systems: Sonsors, A/D and D/A convecapable communication hardware, embedded processors, memories, energy dissipation logic and actuators. The course also features an introduction into real-time open middleware and real-time scheduling. Finally, the implementation of embedded hardware/software co-design (hardware/software partitioning, high-level transspecifications, energy-efficient realizations, compliers for embedded processors) is cove After having attended the course, students shall be able to realize simple embedde students shall realize which relevant parts of technological competences to use in or functional embedded systems. In particular, they shall be able to compare diffe computations and feasible techniques for system-level design. They shall be able to areas of embedded system design specific risks exist.  Students are able to solve similar problems alone or in a group and to present the result students are able to acquire new knowledge from specific literature and to associate with other classes.  Independent Study Time 124, Study Time in Lecture 56  Written exam  90 minutes, contents of course and labs  General Engineering Science (German program, 7 semester): Specialisation Computer S Compulsory Computer Science: Specialisation Computer S pecialisation Computer S Compulsory Computer Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Cor		

Course L0805: Embedded Systems		
Тур	Lecture	
Hrs/wk	3	
СР	4	
Workload in Hours	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 Cyber-Physical Systems. 2<sup>nd</sup> Edition, Springer, 2012., Springer, 2012.</li> </ul>	

Course L0806: Embedd	ourse L0806: Embedded Systems	
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: S	eminars Computer Science a	and Mathematics		
Courses				
Seminar Computational Eng	hematics/Computer Science (L0797) ineering Science (L0796) matics/Computer Science (L1781)	<b>Typ</b> Seminar Seminar Seminar	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in Computer Science, Ma	athematics, and eventually E	ngineering Scienc	e.
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following lea	rning 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				
	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points				
Examination				
and scale	Presentation 20 min and discussion 5 min	l.		
	General Engineering Science (German Compulsory Computer Science: Core qualification: Cor General Engineering Science (English Compulsory Computational Science and Engineering:	mpulsory program, 7 semester): Sp	pecialisation Com	

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, Dr. Mehwish Saleemi, Dr. Haibo Ruan
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: C	omputernetworks and Internet	Security		
Courses				
<b>Title</b> Computer Networks and Into Computer Networks and Into		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 5 1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of Computer Science			
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	Students are able to explain important and common Internet protocols in detail and classify them, ir order to be able to analyse and develop networked systems in further studies and job.			
Skills	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of high a learn and understand it.	amount of professional knowle	edge and ca	n independently
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	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, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			

Course L1098: Computer Networks and Internet Security		
Тур	Lecture	
Hrs/wk	3	
СР	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann	
Language	EN	
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.  This class comprises:  Application layer protocols (HTTP, FTP, DNS) Transport layer protocols (TCP, UDP) Network Layer (Internet Protocol, routing in the Internet) Data link layer with media access at the example of Ethernet Multimedia applications in the Internet Network management Internet security: IPSec Internet security: Firewalls	
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> Further literature is announced at the beginning of the lecture.	

Course L1099: Compute	ourse L1099: Computer Networks and Internet Security	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0731: F	unctional Programming			
Courses				
Title Functional Programming (LC Functional Programming (LC		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 2 2
Functional Programming (LC		Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	INONA			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	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 varying peers. They explain problems and solutions to their peer. They defend their programs orally. They communicate in English.			
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 L	ecture 84		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			

Course L0624: Functional Programming		
Тур	Typ 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.	

ourse L0625: Functional Programming		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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.	

Course L0626: Function	nal Programming
Тур	Recitation Section (small)
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.

Module M0662: N	Iumerical Mathematics I			
Courses				
Title Numerical Mathematics I (L	0417)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	INODE			
Recommended Previous Knowledge	for Tochnomathomaticians	s (german or english) <b>or</b> An	alysis & Line	ar Algebra I +
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results	
Professional				
Competence	<del>}</del>			
	Students are able to			
Knowledge	<ul> <li>name numerical methods for interpolat problems, nonlinear root finding problems</li> <li>repeat convergence statements for the number explain aspects for the practical execution and storage complexitx.</li> </ul>	and to explain their core id umerical methods,	eas,	
	Students are able to			
Skills	<ul> <li>implement, apply and compare numerical</li> <li>justify the convergence behaviour of n solution algorithm,</li> <li>select and execute a suitable solution app</li> </ul>	umerical methods with re	spect to th	e problem and
Personal Competence				
•	Students are able to			
Social Competence	<ul> <li>work together in heterogeneously compound background knowledge), explain the practical aspects regarding the implement</li> </ul>	neoretical foundations and		
	Students are capable			
Autonomy	• to assess whether the supporting the	·		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points	6			
	Written exam			
Examination duration	90 minutes			
and scale	General Engineering Science (German progra Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Compulsory	, 7 semester): Specialisation	on Mechanic	al Engineering
	General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Electi General Engineering Science (German program Focus Theoretical Mechanical Engineering: Computer Science: Specialisation A - Gener Computer Science: Specialisation Computational Electrical Engineering: Core qualification: Electrical	n, 7 semester): Specialisation ive Compulsory n, 7 semester): Specialisation pulsory nal Bioprocess Engineering: I Mathematics: Elective Com	on Mechanic on Mechanic Elective Com	al Engineering
Assignment for the Following Curricula	General Engineering Science (English progra	nm, 7 semester): Speciali , 7 semester): Specialisation Isory , 7 semester): Specialisation	on Mechanic	al Engineering

Focus Biomechanics: 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 Theoretical Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerio	cal Mathematics I
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sabine Le Borne
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 für Ingenieure und Naturwissenschaftler, Springer</li> </ul>

Course 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. Jens-Peter Zemke	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0791: C	omputer Architecture			
Courses				
<b>Title</b> Computer Architecture (L0793)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Computer Architecture (L07	94)	Project-/problem-based Learning	2	2
Computer Architecture (L18	64)	Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Module "Computer Engineering"			
	After taking part successfully, students have rea	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 of 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 of machine instructions and for memory hierarchies.			
Skills	The students are able to describe the organization of processors. They know the different architectural 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 alon	e or in a group and to prese	nt 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 110, Study Time in Lect	ture 70		
Credit points				
-	Written exam			
Examination duration and scale	190 minutes, contents of course and 4 affestation	s from the PBL "Computer a	rchitecture'	ı
Assignment for the Following Curricula				

Course L0793: Compute	er Architecture
Тур	Lecture
Hrs/wk	2
СР	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: Comput	ourse L0794: Computer Architecture		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
СР	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		

ourse L1864: Computer Architecture		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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	oms (L0654)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 4
Introduction to Control Syst Introduction to Control Syst		Recitation Section (small)	2	2
Module Responsible	Prof Herhert Werner			
Admission				
Requirements	Notice			
Recommended Previous Knowledge	Representation of signals and systems in ti	me and frequency domain, Lapla	ce transform	1
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic sy particular explain properties of first:</li> <li>They can explain the dynamics of si of frequency response and root locu:</li> <li>They can explain the Nyquist stabilit</li> <li>They can explain the role of the pha</li> <li>They can explain the way a PID response</li> <li>They can explain issues arising wimplemented digitally</li> </ul>	and second order systems mple control loops and interpret o s y criterion and the stability marg se margin in analysis and synthes controller affects a control loop	dynamic pro ins derived f sis of control in terms c	perties in term from it. I loops of its frequency
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain at 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 frequences response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time at use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			rules s and frequency nuous-time and
Personal Competence	Students can work in small groups to jointly	v solve technical problems, and e	vnerimental	ly validate the
Social Competence	controller designs	y solve teelimear problems, and e	хреттепа	ly validate the
	Students can obtain information from pexperiment guides) and use it when solving		, software	documentation
Autonomy	They can assess their knowledge in weekly	on-line tests and thereby control	their learni	ng progress.
,				
Wanteleast to the	Independent Chiefe Time 124 Chief Time	n Lastura F.C		
Credit points	Independent Study Time 124, Study Time i	ii Lecture 50		
•	Written exam			
Examination duration and scale	120 min			
55416	General Engineering Science (German	program, 7 semester): Special	sation Com	nputer Science
	Compulsory General Engineering Science (German pro	ogram 7 comostor): Specialisati	on Pionroco	cc Enginooring
	Compulsory			
	General Engineering Science (German   Compulsory	orogram, 7 semester): Speciali	sation Nav	al Architecture
	General Engineering Science (German	program, 7 semester): Specia	lisation Civ	vil Engineering
	Compulsory General Engineering Science (German pr	ngram 7 semester): Specialisa	tion Electric	al Engineering
	Compulsory			
	General Engineering Science (German pro Compulsory	ogram, 7 semester): Specialisati	on Biomedic	cal Engineering
	General Engineering Science (German pro	gram, 7 semester): Specialisatio	n Energy ar	nd Enviromenta
	Engineering: Compulsory General Engineering Science (German p	rogram, 7 semester): Specialis	ation Proce	ss Engineering
	Compulsory			
	General Engineering Science (German pro	ogram, / semester): Specialisation	on Mechanic	cal 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	ction to Control Systems
Tvp	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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	

Module M0562: C	omputability and Complexity	, Theory		
Courses				
	<b>Title</b> Computability and Complexity Theory (L0166) Computability and Complexity Theory (L0167)		Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete Algebraic Structures, Automata T	heory, Logic, and Formal Language	e Theory.	
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached 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 complexit of computable functions.			e the complexity
Personal Competence				
Social Competence	Students are able to solve specific probler	ns alone or in a group and to prese	ent the resu	lts 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 Lecture 56		
Credit points	6			
Examination				
Examination duration and scale	20 min			
Assignment for the Following Curricula	General Engineering Science (German pro Compulsory Computer Science: Core qualification: Con General Engineering Science (English pro Compulsory Computational Science and Engineering: S Computational Science and Engineering: S Technomathematics: Specialisation II. Info	npulsory gram, 7 semester): Specialisation Specialisation I. Computer Science: Specialisation Computer Science: E	Computer S	Science: Elective

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

Course L0167: Computa	ourse 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: S	oftware Engineering			
Courses				
<b>Title</b> Software Engineering (L062 Software Engineering (L062		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Automata theory and formal langua</li> <li>Procedural programming or Functio</li> <li>Object-oriented programming, algo</li> </ul>	nal programming		
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learning I	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, students identify the corresponding phase and select an appropriate method. They choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and find errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interface specifications.			
Personal Competence				-
Social Competence	Students practice peer programming. They explain problems and solutions to their peer. They communicate in English.			
Autonomy	Using on-line quizzes and accompanying material for self study, students can assess their level of knowledge continuously and adjust it appropriately. Working on exercise problems, they receive additional feedback.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German pro Compulsory Computer Science: Core qualification: Con General Engineering Science (English pro Compulsory Computational Science and Engineering: S Computational Science and Engineering: S Technomathematics: Specialisation II. Info	npulsory gram, 7 semester): Specialisation ( Specialisation I. Computer Science: Specialisation Computer Science: E	Computer S	cience: Elective mpulsory

Course L0627: Software Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Schupp	
Language	EN	
Cycle	SoSe	
Content	<ul> <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		
СР	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		

Courses				
Title		Typ	Hrs/wk	СР
Management Tutorial (L088 Introduction to Managemen		Recitation Section (large) Lecture	2	3 3
Module Responsible	Prof. Christoph Ihl			
Admission	•			
Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
<b>Educational Objectives</b>	After taking part successfully, students have reache	ed the following learning i	results	
Professional Competence				
Knowledge	After taking this module, students know the import Management, from Planning and Organisation to Ma Controlling. In particular they are able to  • explain the differences between Economi Management and to name important definition explain the most important aspects of and good aspects of entreprneurial projects  • describe and explain basic business function chain management, organization and human innovation management and marketing  • explain the relevance of planning and decimultiple objectives and uncertainty, and Finance  • state basics from accounting and costing and	cs and Management a ons from the field of Mana loals in Management and is as production, procure ressource management ision making in Business explain some basic me	and also to land the sulagement domain the ement and so, information so, esp. in sethods from	nvestment and p-disciplines most importal purcing, suppl n managemen ituations 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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence				
Social Competence	Students are able to  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project  to communicate appropriately and  to cooperate respectfully with their fellow students.			
	Students are able to			
Autonomy	<ul><li>work in a team and to organize the team ther</li><li>to write a report on their project.</li></ul>	mselves		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points				
	Subject theoretical and practical work			
and scale	several written exams during the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Compulsory	7 semester): Specialisation 7 semester): Specialisation 7 semester): Specialis 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering al Engineering al Architectur puter Science

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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: Compulsorv

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management		
Тур	Lecture		
Hrs/wk	3		
СР	3		
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. Kathrin 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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>		
	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003		
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.		
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.		
Literature	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.		
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.		
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.		
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

Module M1269: L	ab Cyber-Physical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Lab Cyber-Physical Systems	(L1740)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Embedded Systems"			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Cyber-Physical Systems (CPS) are tightly int A/D and D/A converters, and actors. Due sensors, processors and actors are comm specification approaches for CPS - in contrast Based on practical experiments using robe modelling of CPS are taught. The lab introduce and their specification techniques (models of petri nets, imperative approaches). Since CP will base on simple control applications, specification tools (MATLAB/Simulink, LabVIII interact with the environment via sensors and After successful attendance of the lab, stude interdependencies between a CPS and its successful with the environment via sensors.	to their particular application on. Accordingly, there is a to classical software engineering the kits and computers, the best into the area (basic notions, of computation, hierarchical autority perform control to the experiments will use EW, NXC) in order to model of actors.	a areas, hig large varie ng approach pasics of sp characteris atomata, da asks, the lal state-of-the cyber-physic	phly specialized by of different nes. pecification and tical properties) ta flow models, po's experiments e-art industrial al models that understand the fact that a CPS
Skills Personal Competence	interacts with the environment via sensors actors. The lab enables students to compare limitations, and to decide which technique to techniques to practical problems. They development, in industry-relevant specification	modelling approaches, to eva o use for a concrete task. They obtain first experiences in	luate their a will be able hardware-re	advantages and to apply these lated software
	Students are able to solve similar problems a	lone or in a group and to prese	nt the recult	e accordingly
	Students are able to solve similar problems alone or in a group and to present the results 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 I	ecture 56		
Credit points				
	Written elaboration			
Examination duration and scale	Execution and documentation of all lab exper	iments		
Assignment for the Following Curricula	General Engineering Science (German progration Compulsory Computer Science: Specialisation Computer a General Engineering Science (English progration Compulsory Computational Science and Engineering: Specompulsory Computational Science and Engineering: Specomputational Specialisation Intelligent System Mechatronics: Specialisation System Design: Mechatronics: Technical Complementary Course	and Software Engineering: Elect m, 7 semester): Specialisation cialisation II. Mathematics & Er cialisation Computer Science: E ms and Robotics: Elective Com Elective Compulsory	ive Compuls Computer S ngineering S	sory cience: Elective cience: Elective

Course L1740: Lab Cyb	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: 0	perating Systems			
Courses				
<b>Title</b> Operating Systems (L1153) Operating Systems (L1154)		<b>Typ</b> Lecture Recitation Section (sm	Hrs/wk 2 all) 2	<b>CP</b> 3 3
Module Responsible	Prof Volker Turau		•	
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Object-oriented programming, algorithms, and data structures</li> <li>Procedural programming</li> <li>Experience in using tools related to operating systems such as editors, linkers, compilers</li> <li>Experience in using C-libraries</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students	nave reached the following learr	ning 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 Tim	ne in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			

Course L1153: Operation	ng 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	Operating Systems, William Stallings, Pearson International Edition     Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium

Course L1154: Operatir	ourse L1154: Operating Systems		
Тур	Recitation Section (small)		
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	See interlocking course		
Literature	See interlocking course		

Module M1062: M	lathematical Statistics			
Courses				
Title  Mathematical Statistics (L13  Mathematical Statistics (L13		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Natalie Neumeyer			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematical Stochastics  Measure Theory and Stochastics			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	Arter taking part successium, students have reac	thed the following learning i	esuits	
Knowledge	<ul> <li>Students can describe basic concepts in Maximum-Likelihood methods for construent optimal tests for parametric probability of application to estimation and test problem and test families. They are able to explain</li> <li>Students can discuss logical connection illustrating these connections with the help</li> <li>They know proof strategies and can reproce</li> </ul>	uction of estimators, opting distributions, sufficiency and so tests in normal distributions them using appropriate examples between these concepts of examples.	mal unfalsifi nd complete on and confi amples.	ed estimators, eness and their dence domains
Skills	<ul> <li>Students can model problems in Mathematical Statistics 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 team language.</li> <li>In doing so, they can communicate new</li> </ul>	concepts according to the	needs of th	eir cooperating
Autonomy	Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.  Students have developed sufficient persistence to be able to work for longer periods in a goal.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: 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: Mathematical 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: Mathem	ourse 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 focus (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 focus.

Module M0598: Mechanical Engineering: Design				
Courses				
<b>Title</b> Embodiment Design and 3D	0-CAD (L0268)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 1
Mechanical Design Project I	(L0695)	Project-/problem-based Learning	3	2
Mechanical Design Project I	I (L0592)	Project-/problem-based Learning	3	2
Team Project Design Metho	dology (L0267)	Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Mechanical Engineering Design     Mechanics     Fundamentals of Materials Science     Production Engineering			
Educational Objectives	After taking part successfully, students ha	ave 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	After passing the module, students are able to:  • independently create sketches, technical drawings and documentations e.g. using 3D CAD,  • design components based on design guidelines autonomously,  • dimension (calculate) used components,  • use methods to design and solve engineering design tasks systamtically and solution-oriented,  • apply creativity techniques in teams.			
Personal Competence				
Social Competence	After passing the module, students are able to:  • develop and evaluate solutions in groups including making and documenting decisions,  • moderate the use of scientific methods,  • present and discuss solutions and technical drawings within groups,  • reflect the own results in the work groups of the course.			
Autonomy	Students are able  • to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),  • To solve engineering design tasks systematically.			

Workload in Hours	Independent Study Time 40, Study Time in Lecture 140
Credit points	6
	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 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 Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

ourse L0268: Embodiment Design and 3D-CAD		
Тур	Lecture	
Hrs/wk	2	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings	
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: Mechanical Design Project I		
Тур	Project-/problem-based Learning	
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</li> <li>(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	Project-/problem-based Learning	
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	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.	

ourse L0267: Team Pr	oject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	Introduction to engineering designing methodology  Team Project Design Methodology  Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides
Literature	<ul> <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				
Courses Fitle		Тур	Hrs/wk	СР
Fundamentals of Materials S	Science I (L1085)	Lecture	2	2
	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
Composites) (L0506) Physical and Chemical Basid	es of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission	None			
Requirements		tica		
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	ucs		
ducational Objectives	After taking part successfully, students have reach	ned the following le	earning results	
Professional				
<b>Competence</b> <i>Knowledge</i>	The students have acquired a fundamental knowledge on metals, ceramics and polymers and cardescribe this knowledge comprehensively. Fundamental knowledge here means specifically the issue 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 callidentify relevant approaches for characterizing specific properties. They are able to trace material			
Skills	The students are able to trace materials phenomena back to the underlying physical and chemical law of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, an stiffness, chemical properties such as corrosion resistance, and to phase transformations such a solidification, precipitation, or melting. The students can explain the relation between processin conditions and the materials microstructure, and they can account for the impact of microstructure of the material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy		0.4		
Workload in Hours Credit points	Independent Study Time 96, Study Time in Lecture 6	e 84		
Examination				
Examination duration				
and scale	General Engineering Science (German program):			
Assignment for the Following Curricula	Compulsory General Engineering Science (German program): S General Engineering Science (German program): S General Engineering Science (German program): S General Engineering Science (German program): S General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory Energy and Environmental Engineering: Core qual General Engineering Science (English program): S General Engineering Science (English program): S General Engineering Science (English program): S General Engineering Science (English program): S General Engineering Science (English program) General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory	Specialisation Biom Specialisation Nava 7 semester): Specialisation Nava 7 semester): Specialisation: Compulso Specialisation Energecialisation Mechapecialisation Naval 7 semester): Specialisation Naval 7 semester): Specialisation Specialisation Naval 7 semester): Specialisation Specialisation Naval 7 semester): Specialisation Specialisation Naval 7 semester): Specialisation Specialisation Naval 7 semester): Specialisation Specialisation Specialisation Naval 7 semester): Specialisation Naval 7 semester Naval 7	edical Engineering: I Architecture: Comcialisation Mechanic cialisation Biomedic Specialisation Nava alisation Energy ar ary rgy and Enviroment canical Engineering: dical Engineering: Architecture: Compialisation Mechanic	Compulsory upulsory cal Engineerin al Architectur nd Enviroment tal Engineerin Compulsory Compulsory culsory cal Engineerin

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			

Course L1095: Physical	and Chemical Basics of Materials Science
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</li> <li>"Detour": Mathematics (complex e-funktion etc.)</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:         <ul> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> </ul> </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 M0680: F	luid Dynamics					
Courses						
<b>Title</b> Fluid Mechanics (L0454) Fluid Mechanics (L0455)	L	<b>Typ</b> .ecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2		
Module Responsible	Prof Thomas Rung					
Admission Requirements						
•	Sound knowledge of engineering mathematics, engineering mechanics and thermodynamics.					
ducational 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 engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using 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 o technical systems. The lecture enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.					
Personal Competence	The students are able to discuss problems and jointly	y develop solution strate	gies.			
Social Competence						
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.					
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points						
Examination						
Examination duration and scale	180 min					
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 (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 Biomedical Engineering 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 Me	echanics		
Тур	cture		
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	
СР	<b>CP</b> 2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	<b>Cycle</b> SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0960: Multibody Systen	Mechanics IV (Kinetics II, ( ns)	Oscillations,	Analytical	Mechanics
Courses				
(L1137) Mechanics IV (Kinetics II, Os (L1138) Mechanics IV (Kinetics II, Os	scillations, Analytical Mechanics, Multibody Systems) scillations, Analytical Mechanics, Multibody Systems) scillations, Analytical Mechanics, Multibody Systems)	Typ Lecture Recitation Section ( Recitation Section (	,	CP 3 2
(L1139)		ricertation Section (	.a. ge, 1	_
Module Responsible Admission Requirements				
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III			
	!	ched the following lea	arning results	
Professional Competence				
Knowledge	<ul> <li>describe the axiomatic procedure used in</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>	mechanical contexts	;	
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 wider problem sets.</li> </ul>			
Personal Competence Social Competence	The students can work in groups and support each			ganize their tim
Autonomy	and learning based on those.			
	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6   Written exam			
Examination duration				
and scale	1 1 2 0 min			
Assignment for the Following Curricula	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (English program): 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 Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineerin Theoretical Mechanical Engineering: Technical	Specialisation Biome Specialisation Naval , 7 semester): Speci , 7 semester): Speci am, 7 semester): S Specialisation Mecha Specialisation Biome Specialisation Naval , 7 semester): Speci , 7 semester): Speci m, 7 semester): Speci pulsory	edical Engineerin Architecture: Co ialisation Mechar ialisation Biomed specialisation Na nical Engineering dical Engineering Architecture: Cor alisation Mechar ialisation Biomed pecialisation Na	g: Compulsory mpulsory mpulsory itical Engineering val Architecture g: Compulsory e: Compulsory inpulsory itical Engineering lical Engineering val Architecture

Course L1137: Mechani	ics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
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	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> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</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: Mechani	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: 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	ent 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	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ctrical engineering		
<b>Educational Objectives</b>	After taking part successfully, students have r	eached the following learning	results	
Professional Competence	Students are able to name the most important			
Knowledge	and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).  They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).  They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)			
Skills	Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.  The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups a	and document them in a comm	non report.	
Autonomy	Students are able to familiarize themselves wi	th new measurement technolo	ogies.	
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	105 minutes			
	General Engineering Science (German progratengineering: Compulsory General Engineering Science (German progratengineering Science) Compulsory General Engineering Science (German progratengineering Science) General Engineering Science (English progratengineering: Compulsory General Engineering Science (English progratengineering: Compulsory General Engineering Science (English progratengineering) General Engineering Science (English progratengineering) General Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory	nm, 7 semester): Specialisation,  on Mechanion Biomedion Biomedion Energy aron Mechanion	cal Engineering cal Engineerin	

Тур	Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	NN		
Language	DE		
Cycle	WiSe/SoSe		
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies determine different gaseous pollutants in automotive exhaust are used.		
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement.		
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated.		
	Experiment 4:Identification of the parameters of a control system and optimal control parameters		
Literature	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmig Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheit 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 B 2455 Bl.1</li> <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 Verläheidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Bost 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bost 1989</li> <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>		

Course L1116: Measurement Technology for Mechanical and Process Engineers		
Тур	Lecture	
Hrs/wk		
СР		
	Independent Study Time 62, Study Time in Lecture 28 Prof. Roland Harig	
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 of the class.	
_	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.	
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.	

Тур	Recitation Section (large)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Roland Harig
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0865: F	undamentals of Proc	duction and Quality Mana	gement	
Courses				
<b>Title</b> Production Process Organiza Quality Management (L0926		<b>Typ</b> Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements				
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully,	, students have reached the following	learning results	
Professional Competence				
Knowledge	Students are able to explain t	the contents of the lecture of the modu	ıle.	
Skills	Students are able to apply the methods and models in the module to industrial problems.		S.	
Personal Competence				
Social Competence	-			
Autonomy	<u>-</u>			
	Independent Study Time 124,	, Study Time in Lecture 56		
Credit points				
Examination				
Examination duration and scale	180 Minuten			
Assignment for the Following Curricula	Elective Compulsory General Engineering Science Elective Compulsory Logistics and Mobility: Special	(German program, 7 semester): Spe (English program, 7 semester): Spe lisation Engineering Science: Elective ( e qualification: Elective Compulsory	ecialisation Mechanic	5 5

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

Course L0926: Quality Management		
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>	

Module M0610: E	lectrical Machines and Actuators			
Courses				
Title		Тур	Hrs/wk	CP
Electrical Machines (L0293) Electrical Machines (L0294)		Lecture Recitation Section (large)	3 2	4 2
Module Responsible	Draf Thorston Korn	Recitation Section (large)		2
Admission				
Requirements	None			
Recommended	Basics of mathematics, in particular complexe nu	ımbers, integrals, differentia	als	
	Basics of electrical engineering and mechanical e	engineering		
	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	Students can to draw and explain the basic princ	ciples of electric and magne	etic fields.	
Knowledge	They can describe the function of the star corresponding equations and characteristic curve parameters of the energy efficiency of the whole	es. For typically used drives	they can ex	plain the major
	Students arw able to calculate two-dimensional circuits with air gap. For this they apply the usua			
Skills	They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.			
Personal Competence Social Competence Autonomy	Inone Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independently the operational performance of electric machines from the characteristic data			
Workload in Hours	Independent Study Time 110, Study Time in Lect	cure 70		
Credit points	6			
	Written exam			
Examination duration and scale	120 Minutes			
	General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (German program Elective Compulsory Electrical Engineering: Core qualification: Elective Energy and Environmental Engineering: Core qualification: Elective Energy and Environmental Engineering: Core qualification: Elective Energy and Environmental Engineering: Core qualification: Elective Engineering Science (English program, Engineering: Compulsory General Engineering Science (English program, Elective Compulsory Computational Science and Engineering: Speciali Logistics and Mobility: Specialisation Engineering Mechanical Engineering: Core qualification: Elective Compulsory	, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation: Compulsory 7 semester): Specialisation 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation Engineering Science: Science: Elective Compulsor	on Mechanic tion Electric on Energy an on Mechanic tion Electric s: Elective C	al Engineering: al Engineering: d Enviromental al Engineering: al Engineering:

Course L0293: Electrica	al Machines
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern
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	Prof. Thorsten Kern, Weitere Mitarbeiter, Dennis Kähler	
Language	DE	
Cycle	SoSe	
	Exercises to the application of electric and magnetic fields.	
Content	Excercises to the operational performance of eletric machines.	
	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: A	dvanced Materials			
Courses				
<b>Title</b> Advanced Materials Charact Advanced Materials Design Advanced Materials Design	(L1091)	<b>Typ</b> Lecture Lecture Recitation Section (large)	Hrs/wk 2 2 2	<b>CP</b> 2 2 2 2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science	e (I and II)		
<b>Educational Objectives</b>	After taking part successfully, stud	dents have reached the following learning	results	
Professional Competence				
Knowledge		ain the properties of advanced materials llic, ceramic, polymeric, semiconductor, i		
Skills	The students will be able to select material configurations according to the technical needs and, in 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.			
<b>Personal Competence</b>				
Social Competence	The students are able to present s	solutions to specialists and to develop ide	as further.	
Autonomy	The students are able to  • assess their own strengths and weaknesses.  • define tasks independently.			
Workload in Hours	Independent Study Time 96, Study	y Time in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory Mechanical Engineering: Core qualification: Elective Compulsory			

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		
	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.

Module M0597: A	dvanced Mechanical Enginee	ering Design		
Courses				
Title Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin	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	CP 2 1 2
Module Responsible	Prof Dieter Krause			
Admission Requirements				
Recommended Previous Knowledge		eering Design		
<b>Educational Objectives</b>	After taking part successfully, students have	ve 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	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically.			
Personal Competence  Social Competence	Students are able to discuss tech	hnical information in the lectur	e supporte	d by activating
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 contenes.</li> <li>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			
Examination  Examination duration  and scale	Written exam 120			
	General Engineering Science (German pro Systems: Compulsory General Engineering Science (German pro Systems Engineering: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compul General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pro Development and Production: Compulsory General Engineering Science (German Theoretical Mechanical Engineering: Comp General Engineering Science (German pro Focus Aircraft Systems Engineering: Comp General Engineering Science (German pro	program): Specialisation Mechanical program): Specialisation Mechanical program): Specialisation Mechanical program): Specialisation Mechanical program): Specialisation Mechanical program, 7 semester): Specialisation ulsory	Engineering anical Eng anical Eng Engineering anical Eng on Mechanic	g, Focus Aircraf ineering, Focus ineering, Focus g, Focus Produc ineering, Focus cal Engineering

Focus Materials in Engineering Sciences: Compulsory

**Following Curricula** 

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

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 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

rse L0264: Advance	ed Mechanical Engineering Design II
	Lecture
Hrs/wk	
СР	
	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  • 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> </ul>
Content	<ul><li>Crank drives</li><li>Sliding bearings</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>
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, 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>
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advanced Mechanical Engineering Design II	
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	SoSe
Content	See interlocking course
Literature	See interlocking course

urse L0262: Advance	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	
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
	Advanced Mechanical Engineering Design I & II  Lecture
Content	Fundamentals of the following machine elements:  Linear rolling bearings  Axes & shafts  Seals  Clutches & brakes  Belt & chain drives  Gear drives  Ficyclic gears  Crank drives  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
	<ul> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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.</li> </ul>
	<ul> <li>Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe aktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

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

Module M1277: M	ED I: Introduction to Anato	omy		
Courses				
<b>Title</b> Introduction to Anatomy (L0	384)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lea	rning results	
Professional Competence	The students can describe basal struc	tures and functions of internal	organs and the i	musculoskeletal
Knowledae	system. The students can describe the basic ma			Huseuloskeletai
Skills	The students can recognize the relation some common diseases; they can explor widespread diseases.	onship between given anatomic ain the relevance of structures	cal facts and the o and their function	development of s in the context
Personal Competence				
Social Competence	The students can participate in cur professional level.	rent discussions in biomedica	al research and	medicine on a
Autonomy	The students are able to access anator on the topic and acquire the relevant k	nical knowledge by themselves nowledge themselves.	, can participate i	n conversations
Workload in Hours	Independent Study Time 62, Study Tim	e in Lecture 28		
Credit points	3			
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Focus Biomechanics: Compulsory Electrical Engineering: Specialisation M 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 Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation	program): Specialisation Biomed program, 7 semester): Special program, 7 semester): Special edical Technology: Elective Consh program): Specialisation program): Specialisation Biomed program, 7 semester): Special program, 7 semester): Special program, 7 semester): Special program, 7 semester): Special Biomechanics: Compulsory Medical Technology and Control Management and Business Admon Artificial Organs and Research	dical Engineering: alisation Biomedic alisation Mechanic mpulsory Mechanical Engi lical Engineering: alisation Mechanic alisation Biomedic of Theory: Elective ministration: Elective egenerative Med	Compulsory cal Engineering; al Engineering, neering, Focus Compulsory al Engineering; al Engineering; Compulsory ve Compulsory ve Compulsory icine: Elective

Course L0384: Introduc	tion to Anatomy	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study	Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange	
Language		
Cycle		
	General Anatomy  1 <sup>st</sup> week:  2 <sup>nd</sup> week:	The Eucaryote Cell The Tissues
	3 <sup>rd</sup> week: 4 <sup>th</sup> week:	Cell Cycle, Basics in Development  Musculoskeletal System
	5 <sup>th</sup> week: 6 <sup>th</sup> week: 7 <sup>th</sup> week:	Cardiovascular System  Respiratory System
Content	8 <sup>th</sup> week:	Genito-urinary System Immune system
	9 <sup>th</sup> week: 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/Michae	l Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012

Signals and Systems (L0432)   Lecture   3		
Signals and Systems (L0432)  Module Responsible   Prof. Gerhard Bauch   Recitation Section (small)   2   2   2    Module Responsible   Prof. Gerhard Bauch   None   Mathematics 1-3   Mathematics 1-3   Mathematics 1-3   Mathematics 1-3   Mathematics 1-3   The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover   Previous Knowledge   Professional   Competence   Professional   Competence   Professional   Competence   The students are able to classify and describe signals and linear time-invariant (LTI) systems using the students are able to classify and describe signals and linear time-invariant (LTI) systems using the students are able to classify and describe signals and linear time-invariant (LTI) systems using the students are able to describe and sanalyse determinists (spals and systems mathematically in both time and image domain. In particular, they understand to additional and system theory. They can accused by the transition of a continuous-time and discrete-time signals and systems caused by the transition of a continuous-time and discrete-time signals and systems to exceed the students are able to describe and analyse determinists (spals and linear time-invariant system signals and systems theory. They can accused by the transition of a continuous-time signal and systems theory. They can analyse and design basic systems regarding methods of signal and systems theory. They can analyse and design basic systems regarding mathematics are able to describe and analyse determinists (spals and linear time-invariant systems the impact of LTI systems on the signal properties in time and frequency domain. The students are able to describe and analyse determinists (spals and linear time-invariant systems the impact of LTI systems on the signal properties in time and frequency domain. The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, softwar	Courses	
Module Responsible   Prof. Gerhard Bauch   Admission   None   Mathematics 1-3   Sevaceted. Further experience with spectral transformations (Fouriseries, Fourier transform, Laplace transform) is useful but not required.    Previous Knowledge   The module is attended to classify and describe signals and linear time-invariant (ITI) systems using methods of signal and system theory. They are able to apply the fundamental transformations.   Knowledge   Mathematics 1-3   Knowledge   Mathematics 1-3   Title	Typ Hrs/wk CP	
Module Responsible   Prof. Gerhard Bauch   Admission   None   Mathematics 1-3   Mathematics 1-4   Mathematics 1-5   Math		
Recommended Previous Knowledge Previous Knowledge Professional Competence  The students are able to classify and describe signals and systems. Good knowledge in maths as cover series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence  The students are able to classify and describe signals and linear time-invariant (ITI) systems using methods of signal and system theory. They are able to apply the fundamental transformation signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand the signals to a discrete-time signal.  The students are able to describe and analyse deterministic signals and signal to a discrete-time signal.  The students are able to describe and analyse and design basic systems required in the signal to a discrete-time signal.  The students are able to describe and analyse and design basic systems required the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They or automation and scale in the students are able to acquire relevant information from appropriate literature sources. They or acquired the summation of a control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours' independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination duration and scale in summation science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Special	Signals and Systems (L043)	Recitation Section (small) 2 2
Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover previous Knowledge by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourisers, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives after taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and systems theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and snalyse federminist signals and systems mathematically in both time and image domain. In particular, thou destand 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 discipant in particular, the invariant system is signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  Focial Competence  The students are able to acquire relevant information from appropriate literature sources. They can asse the impact of LTI systems on the signal properties in time and frequency domain.  The students are able to acquire relevant information from appropriate literature sources. They can also seem to such as a signal to a discrete-time signal.  The students are able to acquire relevant information from appropriate literature sources. They can also seem to such as a signal to a control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours  General Engineering Science (German program): Specialisation Electrical Eng		
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Previous Knowledge series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence 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 (inclinated and increte-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 and belt to describe and analyse deterministic signals and 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 repardir interpretation of 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 regardir interpretation of the students are able to describe and analyse deterministic signals and linear time-invariant system the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They can asset the impact of LTI systems on the signal properties in time and frequency domain.  Workload in Hours in the study Time 110, Study Time in Lecture 70  Credit points  Examination Mitten exam  Examination duration  and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering Compulsory  General Engineering S		Mathematics 1-3
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Professional Competence  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 and some 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 the students are able to describe and analyse deterministic signals and discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Personal Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They conclude the subject of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess 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 Deforces Engineering Compulsory General Engineering Science (German progra	Educational Objectives	After taking part successfully, students have reached the following learning results
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Social Competence The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: 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 Disprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Meraria Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materia	Skills	using methods of signal and system theory. They can analyse and design basic systems regardii important properties such as magnitude and phase response, stability, linearity etc They can asse
The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.  Workload in Hours independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Disprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical 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 Electrical 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 Mechanical Engineering Focus Biomechanics: 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 Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Foc	<b>Personal Competence</b>	
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Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: 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: 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science (Compulsory 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 Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineerin	Autonomy	control their level of knowledge during the lecture period by solving tutorial problems, software too
Examination duration 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 Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess 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 Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems 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 Metalisis in Engineering Science (German program,	Workload in Hours	
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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: 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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0432: Signals and Systems		
Тур	Lecture	
Hrs/wk	3	
СР		
	Independent Study Time 78, Study Time in Lecture 42	
Lecturer Language	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, Stuttgar 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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses 				
<b>Fitle</b> ntroduction to Radiology ar	nd Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	None			
ducational Objectives	After taking part successfully, students	have reached the following	learning results	
Professional Competence				
	<b>Therapy</b> The students can distinguish different radiation therapy.	types of currently used ed	quipment with respe	ct to its use
	The students can explain treatment pl surgery, internal medicine).	ans used in radiation thera	oy in interdisciplinar	y contexts (e.
	The students can describe the pa follow-up care.	tients' passage from the	ir initial admittan	ce through
	Diagnostics			
Knowledge	The students can illustrate the tea angiography and mammography, as we			
	The students can explain the diagnostic technical basis for those techniques.	as well as therapeutic use	of imaging technique	s, as well as t
	The students can choose the right tre needs.	atment method depending	on the patient's clin	ical history a
	The student can explain the influence of	of technical errors on the ima	iging techniques.	
	The student can draw the right conc protocol.	lusions based on the imag	es' diagnostic findin	gs or the err
	<b>Therapy</b> The students can distinguish curative conclusion.	and palliative situations ar	d motivate why the	y came to th
	The students can develop adequate the	erapy concepts and relate it	to the radiation biolo	gical aspects.
	The students can use the therapeutic p	rinciple (effects vs adverse e	effects)	
	The students can distinguish different situation (location of the tumor) and ch			
Skills	The student can assess what an intreatment, sports, social help groups, s			
	Diagnostics			
	The students can suggest solutions for analyses.	or repairs of imaging instru	ımentation after hav	ving done err
	The students can classify results of ima on their knowledge of anatomy, patholo		o different groups of	diseases base
Personal Competence				
	The students can assess the special	social situation of tumor pa	atients and interact	with them in
Social Competence	professional way. The students are aware of the spec diagnostic and therapeutic measures a			ple caused l
	The students can apply their new know The students can introduce younger stu			
Autonomy	The students are able to access anato conversations on the topic and acquire			competently
Workload in Hours	Independent Study Time 62, Study Tim	e in Lecture 28		
Workload in Hours Credit points	Independent Study Time 62, Study Tim 3	e in Lecture 28		

## **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: 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 Assignment for the General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory 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

urse L0383: Introduc	tion to Radiology and Radiation Therapy
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer Language	Prof. Ulrich Carl, Prof. Thomas Vestring
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. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and
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</li> <li>ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer - 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg - erschiener 08.12.2009</li> <li>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</li> <li>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</li> <li>ISBN: 978-3-13-329716-5</li> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer - 1. Auflage - Springer-Verlag GmbH - erschienen 02.06.2000</li> </ul>

Module M1279: M	1ED II: Introduction to Biochemistry and Molecular Biology
Courses	
Title Introduction to Biochemistry	y and Molecular Biology (L0386)  Typ  Lecture  Hrs/wk  CP  2  3
Module Responsible	Prof. Hans-Jürgen Kreienkamp
Admission Requirements	
Recommended Previous Knowledge	None
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• describe basic higmologules:
Skills	The students can  • recognize the importance of molecular parameters for the course of a disease;  • describe selected molecular-diagnostic procedures;  • explain the relevance of these procedures for some diseases
Personal Competence	
Social Competence	The students can participate in discussions in research and medicine on a technical level.
	The students can develop understanding of topics from the course, using technical literature, be themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	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, 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 Management and Business Administration: 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 Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0386: Introduc	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	DE		
Cycle	WiSe		
Content			
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage		
	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008		
Literature			

Courses				
Title	21)	Тур	Hrs/wk	<b>CP</b> 4
Computer Engineering (L03: Computer Engineering (L03:		Lecture Recitation Section (small)	3 1	2
Module Responsible	Prof. Heiko Falk			
Admission				
Requirements Recommended	Basic knowledge in electrical engineering			
Previous Knowledge				
ducational Objectives Professional	After taking part successfully, students have read	ched the following learning	results	
Competence				
Knowledge Skills	This module deals with the foundations of the further from the assembly-level programming down to g  Introduction Combinational logic: Gates, Boolean combinational networks Sequential logic: Flip-flops, automata, syst Technological foundations Computer arithmetic: Integer addition, sub Basics of computer architecture: Programm Memories: Memory hierarchies, SRAM, DR. Input/output: I/O from the perspective of connections, busses  The students perceive computer systems from internal structure and the physical composition highly specific and individual computers can components. They are able to distinguish betw today's computing systems - from gates and circ.  After successful completion of the module, the between a physical computer system and the	algebra, Boolean function ematic hardware design otraction, multiplication and ming models, MIPS single-cy AM, caches of the CPU, principles of p on the architect's perspect of computer systems. The be built based on a coll een and to explain the diffulits up to complete process e students are able to jue	the following ons, hardwords, hardwords architectors, i.e., the students callection of forement abstractors.	topics:  tare synthes  ture, pipelinir  ture, piont-to-poi  ey identify ti  in analyze, he  ew and simp  action layers  erdependenci
Personal Competence  Social Competence	understand the consequences that the executio layers from the assembly language down to gimpact that these low abstraction levels have feasible options.  Students are able to solve similar problems alone Students are able to acquire new knowledge frowith other classes.	ates. This way, they will be on an entire system's pe	e enabled to the state of the state of the result of the r	to evaluate the sand to propo
	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points Examination				
	90 minutes, contents of course and labs			
	General Engineering Science (German progration Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory	, 7 semester): Specialisation,	on Bioproce sation Nava lisation Civ tion Electric on Biomedic n Energy an ation Proces	ss Engineerin al Architectur il Engineerin al Engineerin cal Engineerin d Enviroment ss Engineerin

	Franchisco Control Con
	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, 7 semester): Specialisation Computer Science:
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 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: 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: Compute	urse L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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				
<b>Title</b> Numerical Mathematics I (L	0417)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Numerical Mathematics I (L		Recitation Section (small)		3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Studen for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	ts (german or english) <b>or</b> Ana	alysis & Line	ar Algebra I +
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	name numerical methods for interpola problems, nonlinear root finding problem	ns and to explain their core id numerical methods,	eas,	
	Students are able to			
Skills	<ul> <li>implement, apply and compare numerical</li> <li>justify the convergence behaviour of solution algorithm,</li> <li>select and execute a suitable solution approximately</li> </ul>	numerical methods with re	spect to th	e problem an
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>work together in heterogeneously compand background knowledge), explain practical aspects regarding the impleme</li> </ul>	theoretical foundations and		
	Students are capable			
Autonomy	<ul> <li>to assess whether the supporting th 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 Le	cture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German programs Compulsory General Engineering Science (German programs Focus Materials in Engineering Sciences: Compusory General Engineering Science (German programs Compulsory General Engineering Science (German programs Focus Biomechanics: Compulsory General Engineering Science (German programs Focus Theoretical Mechanical Engineering: Elected General Engineering Science (German programs Focus Theoretical Mechanical Engineering: Combioprocess Engineering: Specialisation A - General Engine	m, 7 semester): Specialisations of the control of t	on Mechanic on Biomedic on Mechanic on Mechanic on Mechanic	tal Engineering al Engineering al Engineering al Engineering al Engineering
Assignment for the Following Curricula	Computer Science: Specialisation Computations Electrical Engineering: Core qualification: Electi General Engineering Science (English progra Compulsory General Engineering Science (English prograr Focus Materials in Engineering Sciences: Comp General Engineering Science (English prograr Compulsory General Engineering Science (English prograr	ve Compulsory ram, 7 semester): Speciali n, 7 semester): Specialisatio ulsory n, 7 semester): Specialisatio	sation Com on Mechanic on Biomedic	al Engineering

Focus Biomechanics: 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 Theoretical Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Mathematics I		
<b>Typ</b> Lecture		
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
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 für Ingenieure und Naturwissenschaftler, Springer</li> </ul>	

Course L0418: Numeric	ourse L0418: Numerical Mathematics I		
Тур	Typ 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. Jens-Peter Zemke		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1333: B	IO I: Implants and Fracture	Healing		
Courses				
<b>Title</b> Implants and Fracture Heali	ng (L0376)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "li Fracture Healing".	ntroduction into Anatomie"	before attending	"Implants and
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following lea	arning results	
Professional Competence				
Knowledge	The students can describe the different w The students can name different treatr morphologies.			
Skills	The students can determine the forces under specific assumptions.	acting within the human b	oody under quasi-s	tatic situations
Personal Competence				
Social Competence	The students can, in groups, solve basic r	umerical modeling tasks for	the calculation of i	nternal forces.
Autonomy	The students can, in groups, solve basic r	umerical modeling tasks for	the calculation of i	nternal forces.
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28		
Credit points	3			
Examination				
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German p Focus Biomechanics: Compulsory General Engineering Science (German p Compulsory General Engineering Science (English pr Focus Biomechanics: Compulsory General Engineering Science (English pr Compulsory Mechanical Engineering: Specialisation Bi Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Im Biomedical Engineering: Specialisation Mi Biomedical Engineering: Specialisation Mi Biomedical Engineering: Specialisation Mi Orientierungsstudium: Core qualification:	rogram, 7 semester): Speci- rogram, 7 semester): Speci- rogram, 7 semester): Speci- omechanics: Compulsory Artificial Organs and F plants and Endoprostheses: edical Technology and Contra anagement and Business Ad	ialisation Biomedic alisation Mechanic alisation Biomedic Regenerative Med Elective Compulso ol Theory: Elective	al Engineering: al Engineering, al Engineering: icine: Elective ry Compulsory
	Technomathematics: Specialisation III. En		Compulsory	

Course L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Cycle	
	Topics to be covered include:
	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
	Nigg, B.: Biomechanics of the musculo-skeletal system
Literature	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat
	riaczer, do-Adas dei Anacomie, band i bewegungsapparac

Courses				
Title	oms (LOSE4)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst Introduction to Control Syst		Recitation Section (sma		2
Module Responsible	Prof. Herbert Werner			
Admission				
Requirements				
Recommended Previous Knowledge	Representation of signals and system	ms in time and frequency domain, Laរុ	liace transforn	n
<b>Educational Objectives</b>	After taking part successfully, stude	nts have reached the following learni	ng results	
Professional Competence				
Knowledge	particular explain properties of they can explain the dynamic of frequency response and rown they can explain the Nyquist They can explain the role of they can explain the way response	amic system behavior in time and for first and second order systems cs of simple control loops and interpretot locus stability criterion and the stability make phase margin in analysis and syntla PID controller affects a control losising when controllers designed in	et dynamic pro rgins derived nesis of contro op in terms o	perties in term from it. I loops of its frequenc
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 and frequence response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time arruse 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	Students can work in small groups t	o igintly solve technical problems, and	l evnerimenta	lly validate the
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate the controller designs  Students can obtain information from provided sources (lecture notes, software documentatio			
Autonomy	experiment guides) and use it when They can assess their knowledge in	solving given problems. weekly on-line tests and thereby cont	rol their learni	ng progress.
7.0.0,				
Workload in Hours	 Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (Ge Compulsory	rman program, 7 semester): Spec	ialisation Con	nputer Science
		nan program, 7 semester): Specialis	ation Bioproce	ess Engineering
	Compulsory General Engineering Science (Ge	rman program, 7 semester): Spec	alisation Nav	al Architectur
	Compulsory	erman program, 7 semester): Spe		
	Compulsory			
	General Engineering Science (Geri Compulsory	man program, 7 semester): Special	sation Electric	cal Engineerin
	General Engineering Science (Gern	nan program, 7 semester): Specialis	ation Biomedi	cal Engineerin
	Engineering: Compulsory	nan program, 7 semester): Specialisa		
	Compulsory	man program, 7 semester): Specia nan program, 7 semester): Specialisa		

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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
Tvp	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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: M	1ED II: Introduction to Phys	iology		
Courses				
Title Introduction to Physiology (	L0385)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	INODE			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lear	ning results	
Professional Competence				
	The students can			
Knowledge	<ul> <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>		ro- and sensory	
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing 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 The students can find solutions to proble			d metrological.
Autonomy	The students can derive answers to que technical literature, by themselves.	stions arising in the course and	d other physiologi	cal areas, using
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	INU MINUTES			
Assignment for the Following Curricula	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, 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			

Course L0385: Introduc	ourse L0385: Introduction to Physiology		
Тур	Lecture		
Hrs/wk	2		
СР	3		
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Gerhard Engler, 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		

erimental Methods	in Biomechanics		
_0377)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
el Morlock			
nended to participate in "Im	plantate und Frakturheilung"	before attending	'Experimentelle
part successfully, students h	nave reached the following lea	arning results	
	ways how bones heal, and the ments for the spine and ho		
es can describe different me te technique for a given task.	asurement techniques for fo	rces and movemer	nts, and choose
nts can describe the bas cs.	ic handling of several ex	kperimental techn	iques used in
s can, in groups, solve basic	experimental tasks.		
s can, in groups, solve basic	experimental tasks.		
t Study Time 62, Study Time	in Lecture 28		
m			
echanics: Compulsory gineering Science (German   gineering Science (English pechanics: Compulsory gineering Science (English pechanics: Specialisation Bengineering: Specialisation Ir Engineering: Specialisation Mengineering: Specialisation Menginee	tiomechanics: Compulsory n Artificial Organs and I mplants and Endoprostheses: ledical Technology and Contr	ialisation Biomedic ialisation Mechanic ialisation Biomedic Regenerative Med Elective Compulso tol Theory: Elective	cal Engineering: cal Engineering; cal Engineering: cal Engineering: cal Engineering:
ing ry all ry all all	ingineering Science (English pry al Engineering: Specialisation B al Engineering: Specialisation ry al Engineering: Specialisation Ir al Engineering: Specialisation M al Engineering: Specialisation M	ingineering Science (English program, 7 semester): Spec ry al Engineering: Specialisation Biomechanics: Compulsory al Engineering: Specialisation Artificial Organs and l ry al Engineering: Specialisation Implants and Endoprostheses: al Engineering: Specialisation Medical Technology and Contr al Engineering: Specialisation Management and Business Ad	ingineering Science (English program, 7 semester): Specialisation Biomedic ry al Engineering: Specialisation Biomechanics: Compulsory al Engineering: Specialisation Artificial Organs and Regenerative Med

Course L0377: Experim	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	

Module M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen	32) F	Typ Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	1			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached	d the following learning r	esults	
Professional Competence				
Knowledge	After taking this module, students know the importation Management, from Planning and Organisation to Ma Controlling. In particular they are able to  • explain the differences between Economic Management and to name important definition • explain the most important aspects of and go aspects of entreprneurial projects • describe and explain basic business functions chain management, organization and human innovation management and marketing • explain the relevance of planning and decis multiple objectives and uncertainty, and Finance • state basics from accounting and costing and	erketing and Innovation, and Management and street of Management and street of Management and street of Management and street of Management and street of Management, and street of Management, sion making in Business explain some basic me	and also to I and the sub agement I name the ment and so information so, esp. in si	nvestment and p-disciplines in most importan purcing, supply n management tuations 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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence				
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture to report on the project     to communicate appropriately and     to cooperate respectfully with their fellow students.		oject and w	rite a coherent
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team then</li> <li>to write a report on their project.</li> </ul>	nselves		
Workload in Hours	   Independent Study Time 110, Study Time in Lecture	70		
Credit points	<del>                                     </del>	. <del> </del>		
· · · · · · · · · · · · · · · · · · ·	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Compulsory	7 semester): Specialisation semester): Specialisation semester): Specialis semester): Specialis semester): Specialis	ation Proces on Biomedic sation Nava sation Com	s Engineering al Engineering I Architecture puter Science

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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 Environmental

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
	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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **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.

Module M0730: C	computer Engineering			
Courses				
Title Computer Engineering (L03: Computer Engineering (L03:		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	· · · · · · · · · · · · · · · · · · ·	,		
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in electrical engineering  The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules:  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.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	This module deals with the foundations of the f from the assembly-level programming down to get a lintroduction  Introduction  Combinational logic: Gates, Boolean combinational networks  Sequential logic: Flip-flops, automata, system technological foundations  Computer arithmetic: Integer addition, suth Basics of computer architecture: Program Memories: Memory hierarchies, SRAM, DR Input/output: I/O from the perspective connections, busses	gates. The module includes to algebra, Boolean function tematic hardware design btraction, multiplication and ming models, MIPS single-cy LAM, caches	he following ons, hardwa division cle architect	topics:  are synthesis,  ure, pipelining
Skills	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 interdependencie between a physical computer system and the software executed on it. In particular, they shat 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 proposite feasible options.			
Personal Competence	I I			
Social Competence	Students are able to solve similar problems alon	e or in a group and to prese	nt the results	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 Lec	ture 56	,	
Credit points	6			
Examination	Written exam			
l	1			

## and scale

**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:

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**

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 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	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	

Title Signals and Systems (L0432)	
Signals and Systems (100332)  Module Responsible   Prof. Gerhard Bauch   Admission   Requirements   Mone   Mathematics 1-3   Mone	
Module Responsible   Prof. Gerhard Bauch   Mone   Admission   Requirements   Mathematics 1-3   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mone   Mathematics 1-3   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mathematics 1-3   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mathematics 1-3   Recommended   Previous Knowledge   Professional   Competence   After taking part successfully, students have reached the following learning results   Professional   Competence   The students are able to classify and describe signals and linear time-invariant (III) system   Professional   Competence   The students are able to classify and describe signals and linear time-invariant continuous-time and discrete-time signals and systems. They can describe and analyse determination   Professional   Pro	P
Module Responsible   Prof. Gerhard Bauch   Admission   None   Mathematics 1-3   Recommended   Previous Knowledge   Previous Knowledge   Previous Knowledge   Previous Knowledge   Previous Knowledge   Previous Knowledge   After taking part successfully, students have reached the following learning results   Professional   Competence   The students are able to classify and describe signals and linear time-invariant (LTI) systemethods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analysed   R. Knowledge   Kn	
Recommended Previous Knowledge Previous Knowledge Previous Knowledge Previous Knowledge Previous Knowledge Previous Knowledge Previous Knowledge Previous Knowledge  But modul is an introduction to the theory of signals and systems. Good knowledge in maths a before the modul is an introduction to the theory of signals and systems. Good knowledge in maths a before the module is a state of the module is a series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives Professional Competence The students are able to classify and describe signals and linear time-invariant (LTI) system onto the signal and systems theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse defects in time domain and image domain which are caused by the transition of a continuous-time and discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invarian signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invarian important properties such as magnitude and phase response, stability, linearity etc They of the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  Social Competence  The students can jointly solve specific problems.  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources, control their level of knowledge during the lecture period by solving tutorial problems, softw clicker system.  Workload in Hours  Examination  General Engineering Science (German program): Specialisation Computer Science: Compulsory  General Engineering Science (German program): Specialisation Frocess Engineering: Compugence In Specialisation Engineering: Compugence In Special Engineering Science (German program): Specialisation Biomedical Engineering: Compugence In Engineerin	
Recommended Previous Knowledge by the modul is an introduction to the theory of signals and systems. Good knowledge in maths a by the modul is an introduction to the theory of signals and systems. Good knowledge in maths a by the modul is an introduction to the theory of signals and systems. Good knowledge in maths a by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation series, Fourier transform, Laplace transform is useful but not required.  Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) systemethods of signal and system theory. They are able to apply the fundamental transformation for incincuous-time and discrete-time signals and systems. They can describe and analyse deterior signals and systems mathematically in both time and image domain. In particular, they under signals and systems are sudders are able to describe and analyse deterministic signals and linear time-invariant using methods of signal and system theory. They can analyse and design basic systems the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. Autonomy or control their level of knowledge during the lecture period by solving tutorial problems, softworth of their level of knowledge during the lecture period by solving tutorial problems, softworth of their level of knowledge during the lecture period by solving tutorial problems, softworth of their level of knowledge during the lecture period by solving tutorial problems, softworth of their level of knowledge during the lecture period by solving tutorial problems, softworth of the students are able to acquire relevant information from appropriate literature sources. Autonomy of the students are able to acquire relevant information from appropriate literatur	
Recommended Previous Knowledge by the modul is an introduction to the theory of signals and systems. Good knowledge in maths a by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation series, Fourier transform, Laplace transform is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence The students are able to classify and describe signals and linear time-invariant (IIT) system methods of signal and system theory. They are able to apply the fundamental transform individuals and systems and discrete-time signals and systems. They can describe and analyse det signals and systems mathematically in both time and image domain. In particular, they under signals and systems are subjected in the domain and image domain which are caused by the transition of a contin signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant using methods of signal and system theory. They can analyse and design basic systems to the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. Autonomy control their level of knowledge during the lecture period by solving tutorial problems, softworkload in Hours  Credit points  Examination duration  and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compute General Engineering Science (German program): Specialisation Drocass Engineering: Compute General Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer General Engineering Scienc	
Previous Knowledge by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives  Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) system methods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse determination and state of the signals and systems mathematically in both time and image domain. In particular, they under effects in time domain and image domain which are caused by the transition of a continusing and to a discrete-time signals.  The students are able to describe and analyse deterministic signals and linear time-invariant signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant signal to the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources.  Autonomy  The students are able to acquire relevant information from appropriate literature sources.  Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compusions of the series of the seri	
Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) system methods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse det signals and systems mathematically in both time and image domain. In particular, they under effects in time domain and image domain which are caused by the transition of a continuous-time domain and image domain which are caused by the transition of a continuous-time important properties such as magnitude and phase response, stability, linearity etc They cether impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. Autonomy  control their level of knowledge during the lecture period by solving tutorial problems, softw citicker system.  Workload in Hours  Credit points 6  Examination duration  General Engineering Science (German program): Specialisation Electrical Engineering: Compusions General Engineering Science (German program): Specialisation Drocess Engineering: Compusions General Engineering Science (German program): Specialisation Drocess Engineering: Compusions General Engineering Science (German program): Specialisation Mechanical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program, 7 semester): Specialisation Process Encompusions General Engineering Science (German program, 7 semester): Specialisati	
Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) system methods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse det signals and systems mathematically in both time and image domain. In particular, they under effects in time domain and image domain which are caused by the transition of a continuous-time domain and image domain which are caused by the transition of a continuous-time important properties such as magnitude and phase response, stability, linearity etc They cether impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. Autonomy  control their level of knowledge during the lecture period by solving tutorial problems, softw citicker system.  Workload in Hours  Credit points 6  Examination duration  General Engineering Science (German program): Specialisation Electrical Engineering: Compusions General Engineering Science (German program): Specialisation Drocess Engineering: Compusions General Engineering Science (German program): Specialisation Drocess Engineering: Compusions General Engineering Science (German program): Specialisation Mechanical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program): Specialisation Biomedical Engineering: Compusions General Engineering Science (German program, 7 semester): Specialisation Process Encompusions General Engineering Science (German program, 7 semester): Specialisati	
The students are able to classify and describe signals and linear time-invariant (LTI) system methods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse det signals and systems mathematically in both time and image domain. In particular, they under the signal of a discrete-time signal in any systems mathematically in both time and image domain. In particular, they under the signal of a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invarian using methods of signal and system theory. They can analyse and design basic systems in mortant properties such as magnitude and phase response, stability, linearity etc They of the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. Autonomy control their level of knowledge during the lecture period by solving tutorial problems, softw clicker system.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compusion General Engineering Science (German program): Specialisation Bioprocess Engineering: Compusiony  General Engineering Science (German program): Specialisation Bioprocess Engineering: Compusiony  General Engineering Science (German program): Specialisation Biomedical Engineering: Compusiony  General Engineering Science (German program): Specialisation Biomedical Engineering: Compusiony  General Engineering Science (German program, 7 semester): Specialisation Process Encompulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Engormy Seneral Engineering Science (German program, 7 semester): Spe	
methods of signal and system theory. They are able to apply the fundamental transform continuous-time and discrete-time signals and systems. They can describe and analyse deterionation and state of 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-invarian using methods of signal and system theory. They can analyse and design basic systems important properties such as magnitude and phase response, stability, linearity etc They can the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources, control their level of knowledge during the lecture period by solving tutorial problems, softworkload in Hours  Credit points  Examination  Written exam  General Engineering Science (German program): Specialisation Electrical Engineering: Compus General Engineering Science (German program): Specialisation Devices Engineering: Compus General Engineering Science (German program): Specialisation Bioprocess Engineering: Compus General Engineering Science (German program): Specialisation Bioprocess Engineering: Compus General Engineering Science (German program): Specialisation Mechanical Engineering: Compusiory  General Engineering Science (German program): Specialisation Bioprocess Engineering: Compusiory  General Engineering Science (German program, 7 semester): Specialisation Process Encompulsory  General Engineering Science (German program, 7 semester): Specialisation Process Encompulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Encompulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Spe	
Skills  skills	rmations eterminis lerstand t
Social Competence The students can jointly solve specific problems. The students are able to acquire relevant information from appropriate literature sources. control their level of knowledge during the lecture period by solving tutorial problems, softw clicker system.  Workload in Hours  Credit points  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compute General Engineering Science (German program): Specialisation Demputer Science: Compulsory General Engineering Science (German program): Specialisation Demputer Science: Compulsory General Engineering Science (German program): Specialisation Demputer Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Demputer Science (German program): Specialisation Demputer Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Encompulsory General Engineering Science (German program, 7 semester): Specialisation Process Encompulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engonulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engonulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineeri	s regardi
Autonomy control their level of knowledge during the lecture period by solving tutorial problems, softwo clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compute General Engineering Science (German program): Specialisation Computer Science: Computer General Engineering Science (German program): Specialisation Process Engineering: Compute General Engineering Science (German program): Specialisation Disprocess Engineering: Computer General Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Bioprocess Engineering: Computer General Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer Computer General Engineering Science (German program, 7 semester): Specialisation Computer Computer Computer General Engineering Science (German program, 7 semester): Specialisation Process Encomputer Computer Computer General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engocus Energy Systems: Computsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engocus Energy Systems: Computsory  General Engineering Science (German program, 7 semester): S	
Autonomy clicker system.  Workload in Hours   Independent Study Time 110, Study Time in Lecture 70  Credit points   6  Examination   Written exam   90 min    General Engineering Science (German program): Specialisation Electrical Engineering: Compus General Engineering Science (German program): Specialisation Process Engineering: Compus General Engineering Science (German program): Specialisation Process Engineering: Compus General Engineering Science (German program): Specialisation Bioprocess Engineering: Compus General Engineering Science (German program): Specialisation Divid- and Environmental Engineerial Engineering Science (German program): Specialisation Mechanical Engineering: Compus General Engineering Science (German program): Specialisation Biomedical Engineering: Compus General Engineering Science (German program): Specialisation Biomedical Engineering: Compus General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerial Engineering Science (German program, 7 semester): Specialisation Computer Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Encompulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Encompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enfocus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mec	
Credit points 6  Examination   Written exam    Examination duration   and scale    General Engineering Science (German program): Specialisation Electrical Engineering: Computer General Engineering Science (German program): Specialisation Computer Science: Compulsor General Engineering Science (German program): Specialisation Process Engineering: Computer General Engineering Science (German program): Specialisation Bioprocess Engineering: Computer General Engineering Science (German program): Specialisation Civil- and Enviromental Engineerial Engineering Science (German program): Specialisation Biomedical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer Computsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerial	
Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Computer General Engineering Science (German program): Specialisation Process Engineering: Computer General Engineering Science (German program): Specialisation Process Engineering: Computer General Engineering Science (German program): Specialisation Bioprocess Engineering: Computer General Engineering Science (German program): Specialisation Electrical Engineering Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer Computer General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerial Engineering Science (German program, 7 semester): Specialisation Computer Computer Computer General Engineering Science (German program, 7 semester): Specialisation Process Engineerial Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerial Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerial Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerial Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Engineer	
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Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory	ory ilsory ilsory inpulsory

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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0432: Signals	and Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
Lecturer Language	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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0684: H	leat Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	None			
Recommended Previous Knowledge		cs		
<b>Educational Objectives</b>	After taking part successfully, students have reac	thed the following learning	results	
Professional Competence				
	The students are able to			
	- describe the different physical mechanism of He	eat Transfer,		
Knowledge	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a c	critical way.		
	The students are able to			
	- understand the physics of Heat Transfer,			
Skills	  - calculate and evaluate complex Heat Transfer p	rocesses,		
	- solve excersises self-consistent and in small gro	ups.		
Personal Competence				
Social Competence	The students are able to discuss in small groups	and develop an approach.		
Autonomy	The students are able to develop a complex prob way. A qualified exchange with other students is		alyse the res	ults in a critical
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Elective Energy Systems: Technical Complementary Course General Engineering Science (English program, Focus Energy Systems: Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Elective Mechanical Engineering: Specialisation Energy Symechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical	7 semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester): Specialisation of semester of semes	on Biomedic on Mechanic ompulsory on Mechanic on Biomedic	al Engineering al Engineering al Engineering al Engineering al Engineering

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	
	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 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	(1.055.4)	Тур	Hrs/wk	CP
Introduction to Control Syst Introduction to Control Syst		Lecture Recitation Section (small	2	4 2
Module Responsible		· · · · · · · · · · · · · · · · · · ·		
Admission				
Requirements	None			
Recommended Previous Knowledge		ems in time and frequency domain, Lapl	ace transforn	1
Educational Objectives	After taking part successfully, stude	ents have reached the following learnin	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>			
<b>Personal Competence</b>				
Social Competence	controller designs	to jointly solve technical problems, and	experimenta	lly validate the
	Students can obtain information experiment guides) and use it when	from provided sources (lecture notents) n solving given problems.	es, software	documentatio
Autonomy	They can assess their knowledge in	weekly on-line tests and thereby contr	ol their learni	ng progress.
W	Independent Co. 1. The Co. Co. C.	The following 50		
	Independent Study Time 124, Study	y Time in Lecture 56		
Credit points  Examination	Written exam			
Examination duration and scale	120 min			
		erman program, 7 semester): Specia	alisation Con	nputer Scienc
	Compulsory General Engineering Science (Gen	man program, 7 semester): Specialisa	tion Bioproce	ss Engineerin
	Compulsory	, ,	•	J
	General Engineering Science (Ge Compulsory	erman program, 7 semester): Specia	ilisation Nav	ai Architectur
	General Engineering Science (G	erman program, 7 semester): Spec	ialisation Civ	vil Engineerin
	Compulsory General Engineering Science (Ger	rman program, 7 semester): Specialis	ation Electric	cal Engineerin
	Compulsory			_
	Compulsory	man program, 7 semester): Specialisa		
		man program, 7 semester): Specialisat	on Energy ar	nd Enviroment
	General Engineering Science (Ge	rman program, 7 semester): Special	sation Proce	ss Engineerin
	Compulsory			

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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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

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: Introduc	tion 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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

ourse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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

	dvanced Mechanical Engine	eering Design		
Courses				
Fitle  Advanced Mechanical Engin   eering Design II (L0265) eering Design I (L0262)	<b>Typ</b> Lecture Recitation Section (la Lecture Recitation Section (la	2	CP 2 1 2	
		Recitation Section (la	rge, z	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Engi</li> <li>Mechanics</li> <li>Fundamentals of Materials Scienc</li> <li>Production Engineering</li> </ul>	-		
ducational Objectives	After taking part successfully, students h	nave reached the following lear	ning results	
Professional				
Competence				
	After passing the module, students are a	able to:		
Knowledge	<ul> <li>explain complex working principle fluidics,</li> <li>explain requirements, selection or machine elements,</li> <li>indicate the background of dimen</li> </ul>	riteria, application scenarios an		
	After passing the module, students are	ahla to:		
Skills	After passing the module, students are a     accomplish dimensioning calculat     transfer knowledge learned in t skills),     recognize the content of technica     evaluate complex designs, techni	ions of covered machine eleme he module to new requireme I drawings and schematic sketo	ents and tasks (	problem solvir
Personal Competence				
Social Competence	Students are able to discuss to methods.	echnical information in the l	ecture supporte	d by activatir
Autonomy	<ul> <li>Students are able to independent</li> <li>Students are able to acquire addie.g. by using the video recordings</li> </ul>	tional knowledge and to recapi		
Workload in Hours	Independent Study Time 68, Study Time	in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the	General Engineering Science (German Focus Aircraft Systems Engineering: Con General Engineering Science (German Focus Materials in Engineering Sciences: General Engineering Science (German Focus Mechatronics: Compulsory General Engineering Science (German Focus Product Development and Product General Engineering Science (German Focus Theoretical Mechanical Engineering General Engineering Science (German Focus Biomechanics: Compulsory General Engineering Science (German Focus Energy Systems: Compulsory Energy Systems: Technical Complement General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Systems Engineering Science (English Focus Aircraft Syst	npulsory program, 7 semester): Specia : Compulsory program, 7 semester): Specia program, 7 semester): Specia tion: Compulsory program, 7 semester): Specia ng: Compulsory program, 7 semester): Specia program, 7 semester): Specia tary Course Core Studies: Electionogram, 7 semester): Special	lisation Mechani lisation Mechani lisation Mechani lisation Mechani lisation Mechani lisation Mechani ive Compulsory lisation Mechani	cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin

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	ed Mechanical Engineering Design II
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	SoSe
Content	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  • Elements of fluidics
	Calculation methods of the following machine elements:
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	
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Tvn	
- 71	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
	Advanced Mechanical Engineering Design I & II  Lecture
Content	Fundamentals of the following machine elements:  Linear rolling bearings  Axes & shafts  Seals  Clutches & brakes  Belt & chain drives  Gear drives  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  Gear drives  Exercise  Clutches & brakes  Belt & Chain drives  Clutches & Shafts  Belt & Chain drives  Gear drives  Gear drives  Sliding bearings  Crank gears  Claulations of hydrostatic systems (fluidics)
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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, I Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe 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

Module M0655: C	omputational Fluid Dynamics I			
Courses				
<b>Title</b> Computational Fluid Dynam Computational Fluid Dynam		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Thomas Rung			
Admission Requirements				
Recommended Previous Knowledge	3	us and series expansions		
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The students are able to list the basic numerics of	partial differential equation	ins.	
Skills	The students are able develop appropriate numerical integration in space and time for the governing partial differential equations. They can code computational algorithms in a structured way.			
Personal Competence  Social Competence	The students can arrive at work results in groups and document them.  The students can independently analyse approaches to solving specific problems.			
Autonomy				
	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				ı
Examination Examination duration and scale	ızn			
Assignment for the Following Curricula	General Engineering Science (German program Compulsory General Engineering Science (German program, Focus Energy Systems: Elective Compulsory Energy Systems: Technical Complementary Course General Engineering Science (English program Compulsory General Engineering Science (English program, Focus Energy Systems: Elective Compulsory Mechanical Engineering: Specialisation Energy Systems: Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering	7 semester): Specialisations of the Core Studies: Elective Core, 7 semester): Specialisations of the Core Studies of the Core	on Mechanic ompulsory sation Nava on Mechanic	al Engineering,

Course L0235: Computational 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	Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.  1. Partial differential equations 2. Foundations of finite numerical approximations 3. Computation of potential flows 4. Introduction of finite-differences 5. Approximation of convective, diffusive and transient transport processes 6. Formulation of boundary conditions and initial conditions 7. Assembly and solution of algebraic equation systems 8. Facets of weighted -residual approaches 9. Finite volume methods 10. Basics of grid generation	
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer	

Course L0419: Computa	ourse L0419: Computational 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> Gas and Steam Power Plant	c (10206)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 5
Gas and Steam Power Plant	•	Recitation Section (large)	1	1
Module Responsible	Prof Alfons Kather			
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	eached the following learning	results	
Professional Competence				
Knowledge	The students can evaluate the development of the electricity demand and the energy conversion route in the thermal power plant, describe the various types of power plant and the layout of the stean 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			
Skills	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 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 compositiviting 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 of the design and development of power plant cycles.  The students are able to do simplified calculations on turbomachinery either as part of a plant, as simplified calculations.			tween heat ar levelop realist technical basic nix composition). software suit ighlight aspec
	component or at stage level.			
Personal Competence				
Social Competence	An excursion within the framework of the lestudents get in this manner direct contact with obtain first-hand experience with a power between technical and political issues.	h a modern power plant in th	is region. T	he students w
Autonomy	The students assisted by the tutors will be able these scenario analyses. In this manner the consolidated and the potential effects from a highlighted. The students are able independ power plants and calculate selected quantities	theoretical and practical kno different process combination ently to analyse the operation	wledge from s and boun	n the lecture dary conditior
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points				
Examination				
Examination duration and scale	Written examination of 120 min			
Assignment for the Following Curricula	General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core of Energy Systems: Technical Complementary Co	m, 7 semester): Specialisation qualification: Compulsory curse Core Studies: Elective Co m, 7 semester): Specialisation m, 7 semester): Specialisation	on Mechanic ompulsory on Energy ar	al Engineering

Course L0206: Gas and	Steam Power Plants
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
	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 plant • Construction materials for power plants • Location of power plants • Location of power plants • Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues:  • Energy balance of a turbomachine • Theory of turbine and compressor stage • Equal and positive pressure blading • Flow losses • Characteristic numbers • Axial and radial design • Design features • Hydraulic turbomachines
	<ul> <li>Pump and water turbine designs</li> <li>Design examples of reciprocating engines and turbomachinery</li> <li>Steam power plants</li> <li>Gas turbine systems.</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>

Course L0210: Gas and	Steam Power Plants
	Recitation Section (large)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plants is 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 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 Cooling operation characteristics of the power plant Construction materials Location of power plants The environmental impact of acidification, fine particulate or CO <sub>2</sub> emissions and the resulting climatic effects are a special focus of the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discussed and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly. Within the framework of the exercise the students learn the use of the specialised software suite BESILON Professional. Mith this tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterwards ask questions and get feedback. The course work has a posit
Literature	<ul> <li>Skripte</li> <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>

Module M1022: R	eciprocating Machinery			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Reciprocat Engines (L0633)	ing Engines and Turbomachinery - Part Reciprocating	Lecture	1	1
Engines (L0634)	ing Engines and Turbomachinery - Part Reciprocating	Recitation Section (large)	1	1
Internal Combustion Engine		Lecture	2 1	2 2
Internal Combustion Engine		Recitation Section (large)	1	2
	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous Knowledge	LINGTMONVINAMICS MIGCHANICS MIACHING FIGMENTS			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned 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 engines, compressors and pumps. They are able to utilize technical terms and parameters as well as aspects 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.  The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design.			
Social Competence	The students are able to communicate and cooperate in a professional environment in the field of machinery design and application.			
Autonomy	The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory			

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

Course L0634: Fundam	ourse L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	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	2
СР	2
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	ourse 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		

Courses				
Title		Typ	Hrs/wk	CP
Management Tutorial (L088 Introduction to Management		Recitation Section (large) Lecture	2 3	3 3
Module Responsible	Prof. Christoph Ihl			
Admission	None			
Requirements Recommended	Basic Knowledge of Mathematics and Business			
Previous Knowledge Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional	5 p			
Competence	After taking this module, students know the imp Management, from Planning and Organisation to Controlling. In particular they are able to  • explain the differences between Econo Management and to name important defini	Marketing and Innovation, mics and Management a	and also to and the su	Investment an
Knowledge	explain the most important aspects of and goals in Management and name the most important aspects of entrepreneurial projects.			
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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence				
Social Competence	<ul> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow s</li> </ul>		roject and w	rite a coherei
	Students are able to			
Autonomy	<ul><li>work in a team and to organize the team the</li><li>to write a report on their project.</li></ul>	nemselves		
Workload in Houre	Independent Study Time 110, Study Time in Lectu	ıre 70		
Credit points		ui C 1 V		
	Subject theoretical and practical work			
	several written exams during the semester			
	General Engineering Science (German program Compulsory General Engineering Science (German progran Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German progran Compulsory General Engineering Science (German progran Compulsory General Engineering Science (German progran Compulsory General Engineering Science (German program, Compulsory	n, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialism, 7 semester): Specialism, 7 semester): Specialism, 7 semester): Specialism,	ation Proces on Biomedic sation Nava sation Com	es Engineerin al Engineerin al Architectur aputer Scienc

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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 Science (English program, 7 semester). Specialisation Civil Engineering.

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M0618: Renewables and Energy Systems				
Courses				
Title Power Industry (L0316) Energy Systems and Energy Renewable Energy (L0313) Renewable Energy (L1434)	y Industry (L0315) Prof. Martin Kaltschmitt	Typ Lecture Lecture Lecture Recitation Section (small)	Hrs/wk 1 2 1	CP 1 2 2 1
Admission	None			
Requirements  Recommended	Inone			
Previous Knowledge	After taking part successfully, students have reach	ad the following learning	roculte	
Professional		led the following learning i	resuits	
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.			
Skills	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.			
Personal Competence  Social Competence	The students are able to analyze suitable technical alternatives and to assess them with technical,			
Autonomy	Students can independently exploit sources , acquire the particular knowledge about the subject area and transform it to new questions.			he subject area
Workload in Hours	Independent Study Time 96, Study Time in Lecture	2 84		
Credit points	6			
	Written exam			
Examination duration and scale	13 DOURS WILLED EXAM			
Assignment for the	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 General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory Energy and Environmental Engineering: Core qualification: 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 General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory Process Engineering: Core qualification: 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	
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> <li>Cost and efficiency calculation</li> </ul> </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 - Systemtechnik, Wirtschaftlichkeit, 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>		

ourse L1434: Renewable Energy			
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/EN		
Cycle	SoSe		
Content	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.  Possible tasks in the field of renewable energies are:  Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, 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: A	dvanced Mechanical Engine	ering Design			
Courses					
Courses		Tire	Hrs/wk	СР	
Title Advanced Mechanical Engineering Design II (L0264)		<b>Typ</b> Lecture	nrs/wk 2	2	
Advanced Mechanical Engir		Recitation Section (large)	2	1	
Advanced Mechanical Engir		Lecture	2	2	
Advanced Mechanical Engir	1	Recitation Section (large)	2	1	
Module Responsible					
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 part successfully, students h	ave reached the following learning	results		
Professional					
Competence	After passing the module, students are a	bla ta			
Knowledge	explain complex working principles and functions of machine elements and of basic elements of fluidics.				
Skills	accomplish dimensioning calculations of covered machine elements,     transfer knowledge learned in the module to new requirements and tasks (problem solving				
Personal Competence					
Social Competence	• Students are able to discuss technical information in the lecture supported by activating				
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 conten 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					
	Written exam				
Examination duration and scale	120				
	General Engineering Science (German p Systems: Compulsory General Engineering Science (German p Systems Engineering: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pu	rogram): Specialisation Mechanical n program): Specialisation Mech ulsory n program): Specialisation Mech	Engineering anical Engi anical Engi	g, Focus Aircraft neering, Focus neering, Focus	

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

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 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

ise zozosi Auvane	ed Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	
СР	2
<b>Workload in Hours</b>	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>
	Calculation methods of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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 Vieweraktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advance	ed Mechanical Engineering Design II
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	SoSe
Content	See interlocking course
Literature	See interlocking course

Typ 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  Lecture  • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Silding bearings • Crank drives • Sliding bearings • Axes & shafts • Cuntents of fluidics  Exercise  • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Elements of fluidics  Exercise  • Calculation methods of the following machine elements: • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Epicyclic gears • Crank gears • Silding bearings	ırse L0262: Advance	ed Mechanical Engineering Design I
Workload in Hours Lecturer Language Cycle  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  Crank drives  Exercise  Calculation methods of the following machine elements:  Linear rolling bearings  Cuthon the bear of the following machine elements:  Cuthon the bear of the following machine elements:  Content  Content  Exercise  Calculation methods of the following machine elements:  Linear rolling bearings  Axes & shafts  Clutches & brakes  Belt & chain drives  Clutches & brakes  Belt & chain drives  Belt & chain drives  Gear drives  Belt & chain drives  Gear drives  Exercise  Cirank gears	Тур	Lecture
Morkload in Hours   Independent Study Time 32, Study Time in Lecture 28		
Lecturer  Language DE  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  • Elements of fluidics  Content  Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Cutches & brakes  • Belt & chain drives  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Belt & chain drives  • Elements of fluidics  Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Gear drives  • Epicyclic gears  • Crank gears	СР	2
Language 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  • Epicyclic gears  • Crank drives  • Sliding bearings  • Elements of fluidics  Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Epicyclic gears  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Belt & chain drives  • Gear drives  • Epicyclic gears  • Crank gears	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Epicyclic gears  • Crank gears	Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Advanced Mechanical Engineering Design I & II  Lecture  • Fundamentals of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Seals  • Clutches & brakes  • Belt & chain drives  • Epicyclic gears  • Crank drives  • Sliding bearings  • Content  Content  Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Calculation methods of the following machine elements:  • Content  • Clutches & brakes  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Crank gears	Language	DE
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  • Elements of fluidics   Exercise  • Calculation methods of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Clutches & brakes  • Belt & chain drives  • Gear drives  • Gear drives  • Gear drives  • Epicyclic gears  • Crank gears	Cycle	WiSe
<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>Elements of fluidics</li> <li>Exercise         <ul> <li>Calculation methods of the following machine elements:                 <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <l>Clutches &amp; brakes</l></ul></li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> </ul> </li></ul>		
	Content	<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> <li>Elements of fluidics</li> </ul> Exercise <ul> <li>Calculation methods of the following machine elements:</li> <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> </ul>
	Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlaaktuelle 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, Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe aktuelle Auflage.</li> </ul>
<ul> <li>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., Springer Viewe</li> </ul>		Sowie weitere Bücher zu speziellen Themen

Course L0263: Advance	ed 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

Signals and Systems (L0432) Signals and Systems (L0433)  Module Responsible Admission Requirements  Mathematics 1-3  Recommended Previous Knowledge by the moduls Mathematik 1-3 is expected. Further escries, Fourier transform, Laplace transform) is useful by the moduls Mathematik 1-3 is expected. Further escries, Fourier transform, Laplace transform) is useful Competence  Mathematics 1-3  The modul is an introduction to the theory of signals as by the moduls Mathematik 1-3 is expected. Further escries, Fourier transform, Laplace transform) is useful competence  Mathematics 1-3  The modul Mathematik 1-3 is expected. Further escries, Fourier transform, Laplace transform) is useful competence of signal and system theory. They are absorbinuous-time and discrete-time signals and system effects in time domain and image domain which are signals and systems mathematically in both time and effects in time domain and image domain which are signal to a discrete-time signal.  The students are able to describe and analyse determined to a discrete-time signal and system theory. They comportant properties such as magnitude and phase reflected to the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal and system theory. They compact of LTI systems on the signal system theory. They compact of the impact of LTI systems on the signal system theory. They comp	and systems. Good know experience with spectra I but not required.  I the following learning remails and linear time-invalue to apply the fundarems. They can describe dimage domain. In particular caused by the transforministic signals and linear analyse and design response, stability, linear time and frequency domain from appropriate literiod by solving tutorial	wledge in mathal transformateresults  variant (LTI) symental transformateresults	rstems using commentations determinist derstand the tinuous-ting regarding years asseets. They can asseets.
Signals and Systems (L0432) Signals and Systems (L0433)  Module Responsible Prof. Gerhard Bauch  Admission Requirements  Mathematics 1-3  Recommended Previous Knowledge by the moduls Mathematik 1-3 is expected. Further of series, Fourier transform, Laplace transform) is useful by the moduls Mathematik 1-3 is expected. Further of series, Fourier transform, Laplace transform) is useful Competence  Knowledge  Knowledge  Knowledge  Knowledge  Knowledge  Knowledge  Fetsuins in the domain and system theory. They are aboutinuous-time and discrete-time signals and system signals and system signals and system signal to a discrete-time signal in both time and effects in time domain and image domain which are signal to a discrete-time signal.  The students are able to classify and describe signal signals and system theory. They are aboutinuous-time and discrete-time signal in both time and effects in time domain and image domain which are signal to a discrete-time signal.  The students are able to describe and analyse determusing methods of signal and system theory. They comportant properties such as magnitude and phase in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal properties in the impact of LTI systems on the signal and system theory. They circle the impact of LTI systems on the signal and system theory. They circle the impact of LTI systems on the signal and system theory. They circle the impact of LTI systems on the signal and system theo	and systems. Good know experience with spectral but not required.  I the following learning rems. They can describe dimage domain. In partire caused by the transitive can analyse and design response, stability, lineatime and frequency domain from appropriate literiod by solving tutorial	wledge in mathal transformateresults  variant (LTI) symental transformateresults	ns as cover ions (Fouri estems usir ormations determinist derstand ti tinuous-tin riant syster ns regardir y can asse
Module Responsible   Admission Requirements   None	and systems. Good know experience with spectra I but not required.  I the following learning remains and linear time-invalue to apply the fundarems. They can describe dimage domain. In particular caused by the transforministic signals and linear time and frequency domain analyse and design response, stability, linear time and frequency domain from appropriate literiod by solving tutorial	wledge in mathal transformateresults  variant (LTI) symental trans	ns as cover ions (Fouri estems usir ormations determinist derstand ti tinuous-tin riant syster ns regardir y can asse
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The students can jointly solve specific problems.  The students are able to acquire relevant information control their level of knowledge during the lecture perclicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 7  Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specific General Engineerin	period by solving tutorial		
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ourse L0432: Signals and Systems		
Тур	ecture	
Hrs/wk	3	
СР		
	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 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, Stuttgal 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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0596: A	dvanced Mechanical Design Proje	ct		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Desig	n Project (L0266)	Project-/problem-based Learning	4	6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanical Engineering: Design     Advanced Mechanical Engineering Design			
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	! !			
Knowledge	After passing the module, students are able to:  express the procedure for systematically handling of complex design tasks, describe working principles, their use and combination possibilities, explain guidelines for designing for function and manufacturing, explain advanced use-oriented knowledge of machine elements.			
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	After passing the module, students are able to:			
Social Competence				
Autonomy	<ul> <li>After passing the module, students are able to:</li> <li>independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,</li> <li>to independently solve problems.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points				
	Written exam			
Examination duration and scale	180			
Assignment for the Following Curricula	General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Product Development and Production: Com General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compul General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Product Development and Production: Com General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Compul Mechanical Engineering: Core qualification: Compulsory Computer Compulsory Computer C	7 semester): Specialisati pulsory 7 semester): Specialisati alsory 7 semester): Specialisati alsory 7 semester): Specialisati pulsory 7 semester): Specialisati pulsory 7 semester): Specialisati alsory	on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineering, cal Engineering, cal Engineering, cal Engineering,

Course L0266: Advanced Mechanical Design Project		
Тур	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	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.  • Getriebekonstruktion in Einzelarbeit  • Erarbeitung von Lösungsprinzipien  • Berechnung von Maschinenelementen  • Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten  • Erstellung einer ausführlichen Dokumentation  • Lösungsfindung  • Methodische Erarbeitung von prinzipiellen Lösungskonzepten  • Erstellen einer Dokumentation	
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 M1320: S	imulation and Design of Mechat	ronic Systems		
Courses				
Simulation and Design of M	echatronic Systems (L1822) echatronic Systems (L1823) echatronic Systems (L1824)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	LNONE	lone		
Recommended Previous Knowledge	fundatmentals of mechanics, control theory and electrical engineering			
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	Students are able to describe methods and calculations for design, modeling, simulation and optimization of mechatronic systems.			
Skills	Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify simulate and design simple systems and implement those in laboratory conditions.			ey can identify,
Personal Competence				
Social Competence				get groups.
Autonomy	Students are able to recognize and improve kn With instructor assistance, students are able to course of study.		,	define a further
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula		m, 7 semester): Specialisation m, 7 semester): Specialisation	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic ulsory Compulsory	al Engineering, al Engineering, al Engineering, al Engineering, al Engineering,

Course L1822: Simulati	on 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 ® and Simulink®
Litoraturo	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung

Course L1823: Simulati	ourse 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	come (1.0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst Introduction to Control Syst		Recitation Section (sma		2
Module Responsible	Prof. Herbert Werner			
Admission				
Requirements				
Recommended Previous Knowledge		ems in time and frequency domain, La	Diace transforn	1
Educational Objectives	After taking part successfully, stud	dents have reached the following learni	ng 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	<u> </u>			
Social Competence	students can work in small groups controller designs	s to jointly solve technical problems, an	d experimenta	lly validate the
	Students can obtain information experiment guides) and use it who	n from provided sources (lecture no en solving given problems.	es, software	documentatio
Autonomy		n weekly on-line tests and thereby con	rol their learni	ng progress.
Waster dr	Independent Could T' 200 C'	du Time in Leature 50		
	Independent Study Time 124, Stud	ay Time in Lecture 56		
Credit points  Examination	Written exam			
Examination duration and scale	120 min			
		German program, 7 semester): Spec	ialisation Con	nputer Scienc
	Compulsory General Engineering Science (Ge	rman program, 7 semester): Specialis	ation Bioproce	ss Engineerin
	Compulsory General Engineering Science (G	German program, 7 semester): Spec	ialisation Nav	al Architectur
	Compulsory			
	General Engineering Science (Compulsory	German program, 7 semester): Spe	cialisation Civ	/il Engineerin
	General Engineering Science (Ge	erman program, 7 semester): Special	isation Electric	cal Engineerin
	Compulsory General Engineering Science (Ge	rman program, 7 semester): Specialis	ation Biomedia	cal Engineerin
	Compulsory			
	General Engineering Science (General Engineering: Compulsory	rman program, 7 semester): Specialisa	tion Energy ar	nd Enviroment
		erman program, 7 semester): Specia	lisation Proce	ss Engineerin
	Compulsory	,		3

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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
Tvp	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 Root locus design of PID controllers  Frequency response techniques
Literature	<ul> <li>Computer-based exercises throughout the course</li> <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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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	

Module M0730: C	
Courses	
Title	Typ Hrs/wk CP
Computer Engineering (L03	
Computer Engineering (L03	
Module Responsible	
Admission Requirements	INONE
	Basic knowledge in electrical engineering
Previous Knowledge	
Professional Objectives	After taking part successfully, students have reached the following learning results
Competence	
Knowledge	<ul> <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-poir connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify th internal structure and the physical composition of computer systems. The students can analyze, hor highly specific and individual computers can be built based on a collection of few and simple
Skills	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 interdependencied between a physical computer system and the software executed on it. In particular, they shad 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 present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
	Written exam
Examination duration and scale	90 minutes, contents of course and labs
	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 Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process 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 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  Control Engineering Science (English program 7 computer Science)
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

C	F
Course L0321: Compute	er Engineering
Тур	Lecture
Hrs/wk	3
СР	4
<b>Workload in Hours</b>	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		
СР	2		
<b>Workload in Hours</b>	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 M0599: II	ntegrated Product Development a	nd Lightweight D	esign		
Courses					
Title		<b>Typ</b> Project-/problem-based	Hrs/wk	СР	
CAE-Team Project (L0271)  Development of Lightweigh  Integrated Product Develop		Learning Lecture Lecture	2 2	2 2 2	
Module Responsible					
Admission					
Requirements	Advanced Knowledge about engineering design:				
Recommended	Fundamentals of Mechanical Engineering Design				
Previous Knowledge	Mechanical Engineering: Design				
	Advanced Mechanical Engineering Design				
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results		
Professional Competence					
•	After completing the module, students are capabl	e of:			
Knowledge	<ul> <li>explaining the functional principle of 3D-CA</li> </ul>	AD-Systems, PDM- and FEN	1-Systems		
	<ul> <li>describing the interaction of the different C</li> </ul>	CAE-Systems in the produc	t developme	nt process	
	After completing the module, students are able to	):			
	, ,				
Skills	<ul> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such as 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 are able to	· ·			
				. (	
Social Competence	<ul> <li>To develop a project plan and allocate we group discussions</li> </ul>	ork appropriate work pac	kages in th	e framework of	
	Present project results as a team for instance in a presentation				
	Students are capable of:				
Autonomy	independently adapt to a CAE-Tool and con	nplete a given practical ta	sk with it		
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84			
Credit points	6				
	Written exam				
Examination duration and scale					
	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 Product Development and Production: 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 Product Development and Production: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory				

Course L0271: CAE-Team Project		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	SoSe	
	<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: Develop	ment 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: Integrat	red Product Development I
Тур	Lecture
Hrs/wk	2
СР	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>

Module M0767: A	eronautical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Aircraft Sy	stems (L0741)	Lecture	2	2
Fundamentals of Aircraft Sy		Recitation Section (small)	1	1
Air Transportation Systems		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 the	hermodynamics		
<b>Educational Objectives</b>	After taking part successfully, students h	nave 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.			
<b>Personal Competence</b>				
Social Competence	Students are made aware of interdiscipli	nary 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			
Examination				
Examination duration and scale	150 min			
	General Engineering Science (German   Focus Aircraft Systems Engineering: Con General Engineering Science (English p Focus Aircraft Systems Engineering: Con Logistics and Mobility: Specialisation Log Mechanical Engineering: Specialisation A	npulsory program, 7 semester): Specialisation pulsory pistics and Mobility: Elective Compul	on Mechanio sory	3 3

Course L0741: Fundam	ourse 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		
	<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: Fundam	ourse 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	Lecture	
Hrs/wk	2	
СР	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 Tran	sportation Systems
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	Practical exercises to understand
Literature	Hünnecke: Das moderne Verkehrsflugzeug von heute Flühr: Avionik und Flugsicherungstechnik

Module M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives Professional	After taking part successfully, students have reach	ed the following learning	results	
Competence				
Knowledge	After taking this module, students know the important Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Econom Management and to name important definiti. • explain the most important aspects of and aspects of entreprneurial projects. • describe and explain basic business function chain management, organization and huma innovation management and marketing. • explain the relevance of planning and demultiple objectives and uncertainty, and Finance. • state basics from accounting and costing and	Marketing and Innovation, nics and Management at ions from the field of Management and unsured in Management and unsured in ressource management cision making in Busines explain some basic me	and also to land the sulagement in name the ement and so, informations, esp. in sethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
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 risk  • analyse production and procurement systems and Business information systems  • analyse and apply basic methods of marketing  • select and apply basic methods from mathematical finance to predefined problems  • apply basic methods from accounting, costing and controlling to predefined problems			
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 coherent report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team the</li> <li>to write a report on their project.</li> </ul>	emselves		
Workload in Hours	J Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	<u> </u>			
Examination	Subject theoretical and practical work			
Examination duration and scale	I Several Written exams diiring the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

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

Following Curricula 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:

General Éngineering 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 Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	ction to Management
Тур	Lecture
Hrs/wk	3
СР	3
	Independent Study Time 48, Study Time in Lecture 42
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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **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: A	dvanced Mechanical Engin	neering Design		
Courses				
Title Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin	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	CP 2 1 2
Module Responsible		recitation section (large)		
Admission Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	After passing the module, students are  • explain complex working principulation fluidics,	oles and functions of machine elemen criteria, application scenarios and pra		
Skills	After passing the module, students are able to:  • accomplish dimensioning calculations of covered machine elements,  • transfer knowledge learned in the module to new requirements and tasks (problem solving skills),  • recognize the content of technical drawings and schematic sketches,  • evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss methods.	technical information in the lecture	e supporte	d by activating
Autonomy		ntly deepen their acquired knowledge ditional knowledge and to recapitulate gs of the lectures.		
Workload in Hours	Independent Study Time 68, Study Tim	ne in Lecture 112		
Credit points				
Examination				
Examination duration and scale	1 1 20			
	General Engineering Science (German Systems: Compulsory General Engineering Science (German Systems Engineering: Compulsory General Engineering Science (Germ Materials in Engineering Sciences: Com General Engineering Science (Germ Mechatronics: Compulsory General Engineering Science (German Development and Production: Compuls General Engineering Science (Germ Theoretical Mechanical Engineering: Compulsory Compulsory General Engineering Science (German Development and Production: Compulsory Compulsory Compulsory Compulsory Compulsory Computer Comp	program): Specialisation Mechanical nan program): Specialisation Mechanical nan program): Specialisation Mechanical program): Specialisation Mechanical cory nan program): Specialisation Mechanical sory	Engineering anical Engi anical Engi Engineering	g, Focus Aircraff neering, Focus neering, Focus g, Focus Product

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 **Following Curricula** 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 L0265: Advanced Mechanical Engineering Design II	
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	SoSe
Content	See interlocking course
Literature	See interlocking course

	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	
СР	2
<b>Workload in Hours</b>	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
Content	2 Elements of Indiales
	Calculation methods of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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 Viewe aktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

Course L0263: Advanced Mechanical Engineering Design I		
Typ 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	

Signals and Systems (L0432)  Lecture 3		
Signals and Systems (L0432)  Module Responsible Prof. Gerhard Bauch Admission Requirements  Mathematics 1-3  Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in mathematics is an introduction to the theory of signals and systems. Good knowledge in mathematics is expected. Further experience with spectral transformatic series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence The students are able to classify and describe signals and linear time-invariant (LTI) symethods of signal and system theory. They are able to apply the fundamental transformatic series, Fourier transforms and discrete-time signals.  Knowledge Stables Knowledge Kn		
Module Responsible   Prof. Gerhard Bauch   Admission   Requirements   None   Mathematics 1-3		СР
Module Responsible   Prof. Gerhard Bauch   Admission   Requirements   Mathematics 1-3   Mathematics 1-		4
Admission Requirements  Recommended Previous Knowledge Mathematics 1-3  Recommended Previous Knowledge Mathematics 1-3 is expected. Further experience with spectral transformat series. Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence  The students are able to classify and describe signals and linear time-invariant (ITI) symethods of signal and system theory. They are able to apply the fundamental transfor continuous-time and discrete-time signals and systems. They can describe and analyse methods of signal and system smathematically in both time and image domain. In particular, they un effects in time domain and image domain which are caused by the transition of a consignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant sign methods of signal and system theory. They can analyse and design basic system. The students are able to describe and analyse deterministic signals and linear time-invariant signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant signal protrant properties such as magnitude and phase response, stability, linearity etc. The the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature source control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Examination duration  Autonomy  General Engineering Science (German program): Specialisation Computer Science: Computer Science (German program): Specialisation Electrical Engineering: Compensal Engineering Science (German program): Specialisation Bioprocess Engineer	)	2
Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in mathematics 1:3  Recommended Previous Knowledge by the moduls Mathematik 1:3 is expected. Further experience with spectral transformat series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) symethods of signal and system theory. They are able to apply the fundamental transformation of signal systems mathematically in both time and image domain. In particular, they effects in time domain and image domain which are caused by the transition of a consignal to a discrete-time signals. The students are able to describe and analyse deterministic signals and linear time-invariant (using methods of signal and system theory. They can analyse and design basic systems the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature source Autonomy control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination Written exam  Examination Written exam  Examination Written exam  Examination General Engineering Science (German program): Specialisation Electrical Engineering: Comp General Engineering Science (German program): Specialisation Process Engineering: Comp General Engineering Science (German program): Specialisation Bioprocess Engineering: Comp General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7	Prof. Ger	
Recommended Previous Knowledge by the modulis an introduction to the theory of signals and systems. Good knowledge in mathematical Previous Knowledge by the moduls Mathematik 1-3 is expected. Further experience with spectral transformat series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence  The students are able to classify and describe signals and linear time-invariant (ITI) symethods of signal and system theory. They are able to apply the fundamental transformation of signal sharp and discrete-time signals and systems. Professional systems mathematically in both time and image domain. In particular, they un effects in time domain and image domain which are caused by the transition of a consignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant (ITI) symethems of the students of signal and system theory. They can analyse and design basic system important properties such as magnitude and phase response, stability, linearity etc The the students are able to describe and analyse deterministic signals and linear time-invariant in the students are able to acquire relevant information from appropriate literature source Autonomy.  Personal Competence  Fine students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature source Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Dioprocess Compulsory  General Engineering Science (German program, 7 sem	None	
Previous Knowledge   by the moduls Mathematik 1-3 is expected. Further experience with spectral transformal series, Fourier transform, Laplace transform) is useful but not required.    Educational Objectives	Mathema	
Professional Competence  The students are able to classify and describe signals and linear time-invariant (LTI) symethods of signal and system theory. They are able to apply the fundamental transfer continuous-time and discrete-time signals and systems. They can describe and analyse of signals and systems and the and image domain. In particular, they un effects in time domain and image domain which are caused by the transition of a consignal to a discrete-time signal and system theory. They can analyse and design basic system using methods of signal and system theory. They can analyse and design basic system important properties such as magnitude and phase response, stability, linearity etc The the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature source Autonomy control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours  Credit points  Examination  Mitten exam  Examination duration  General Engineering Science (German program): Specialisation Electrical Engineering: Come General Engineering Science (German program): Specialisation Computer Science: Computer General Engineering Science (German program): Specialisation Decorptive Science: Computer Compulsory  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program): Temester): Specialisation Process Compulsory  General Engineering Science (German program): 7 semester): Specialisation Diomedical Compulsory  General Engineering Science (German program, 7 semester): Specialisation	by the m	
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Skills using methods of signal and system theory. They can analyse and design basic system important properties such as magnitude and phase response, stability, linearity etc The the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature source control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compensation and scale  General Engineering Science (German program): Specialisation Process Engineering: Compensation Engineering Science (German program): Specialisation Bioprocess Engineering: Compensation Engineering Science (German program): Specialisation Bioprocess 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): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Science (German program, 7 semester): Specialisation Biomedical Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems Engineering Compulsory  General Engineering Science (German program, 7 semester): Sp	methods continuo signals a effects ir	nsformatio se determi understan
The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature source control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours  Credit points  Examination  Examination  Mritten exam  General Engineering Science (German program): Specialisation Electrical Engineering: Come General Engineering Science (German program): Specialisation Computer Science: Compuls General Engineering Science (German program): Specialisation Bioprocess Engineering: Come General Engineering Science (German program): Specialisation Mechanical Engineering: Come General Engineering Science (German program): Specialisation Mechanical Engineering: Come General Engineering Science (German program): Specialisation Mechanical Engineering: Come General Engineering Science (German program): Specialisation Biomedical Engineering: Come General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems Engineering: Compulsory	using me importan	tems rega
Autonomy Control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical 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 Mechanical 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): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Aircraft Systems Engineering: Compulsory		
Control their level of knowledge during the lecture period by solving tutorial problems, so clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Company General Engineering Science (German program): Specialisation Computer Science: Computer General Engineering Science (German program): Specialisation Process Engineering: Company General Engineering Science (German program): Specialisation Bioprocess Engineering: Computer General Engineering Science (German program): Specialisation Civil- and Environmental Engineerial Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer General Engineering Science (German program): Specialisation Electrical Computer General Engineering Science (German program, 7 semester): Specialisation Electrical Computer General Engineering Science (German program, 7 semester): Specialisation Process Computer General Engineering Science (German program, 7 semester): Specialisation Bioprocess Computer General Engineering Science (German program, 7 semester): Specialisation Biomedical Computer General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Computer German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer Computer German Program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer Computer German Program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer German Program, 7 semester): Specialisation Mechanica	The stud	
Credit points 6  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Computer Science: Computer Science (German program): Specialisation Process Engineering: Computer Engineering Science (German program): Specialisation Process Engineering: Computer Engineering Science (German program): Specialisation Bioprocess Engineering: Computer Engineering Science (German program): Specialisation Mechanical Engineering: Computer Engineering Science (German program): Specialisation Mechanical Engineering: Computer Engineering Science (German program): Specialisation Biomedical Engineering: Computer Engineering Science (German program): Specialisation Biomedical Engineering: Computer Engineering Science (German program, 7 semester): Specialisation Electrical Computer General Engineering Science (German program, 7 semester): Specialisation Process Computer General Engineering Science (German program, 7 semester): Specialisation Bioprocess Computer General Engineering Science (German program, 7 semester): Specialisation Biomedical Computer General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Computer German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computer (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Engineering: Computer (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semeste	control t	
Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compute General Engineering Science (German program): Specialisation Computer Science: Compute General Engineering Science (German program): Specialisation Process Engineering: Compute General Engineering Science (German program): Specialisation Bioprocess Engineering: Computer Science (German program): Specialisation Civil- and Environmental Engineerial Engineering Science (German program): Specialisation Mechanical Engineering: Computer General Engineering Science (German program): Specialisation Biomedical Engineering: Computer General Engineering Science (German program, 7 semester): Specialisation Electrical Computer General Engineering Science (German program, 7 semester): Specialisation Computer General Engineering Science (German program, 7 semester): Specialisation Process Computer General Engineering Science (German program, 7 semester): Specialisation Bioprocess Computer General Engineering Science (German program, 7 semester): Specialisation Biomedical Computer General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Computer (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (Germa		
Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compute General Engineering Science (German program): Specialisation Process Engineering: Compute General Engineering Science (German program): Specialisation Bioprocess Engineering: Compute General Engineering Science (German program): Specialisation Bioprocess Engineering: Compute General Engineering Science (German program): Specialisation Civil- and Environmental Engineerial Engineering Science (German program): Specialisation Mechanical Engineering: Compute General Engineering Science (German program): Specialisation Biomedical Engineering: Compute General Engineering Science (German program, 7 semester): Specialisation Electrical Compute General Engineering Science (German program, 7 semester): Specialisation Compute Compute General Engineering Science (German program, 7 semester): Specialisation Process Compute General Engineering Science (German program, 7 semester): Specialisation Bioprocess Compute General Engineering Science (German program, 7 semester): Specialisation Biomedical Compute General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compute (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Energy Systems: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Engin	6	
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General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory	General General General General General General General General Compuls General Compuls General Compuls General Compuls General Compuls General Focus Bir General Focus Air General Focus Air General Focus Ma General Focus Ma General Focus Ma General Focus Ma General Focus Ma General Focus Th	pulsory mpulsory Compulso al Engenee Compulso cal Enginee

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Course L0432: Signals	and Systems
Тур	Lecture
Hrs/wk	3
СР	
	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 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 (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0988: S	tructural Materials			
Courses				
<b>Title</b> Fundamentals of Mechanica Welding Technology (L1123	l Properties of Materials (L1090) )	<b>Typ</b> Lecture Lecture	<b>Hrs/wk</b> 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science			
<b>Educational Objectives</b>	After taking part successfully, students h	nave reached the following lea	rning 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 o 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 mechanical 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.			properties and table technique
Personal Competence				
Social Competence	none			
Autonomy		- '- I I		
	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points Examination				
Examination duration and scale				
Assignment for the Following Curricula				

Course L1090: Fundamentals of Mechanical Properties of Materials			
Тур	Lecture		
Hrs/wk			
СР			
Workload in Hours	lependent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Norbert Huber		
Language	DE		
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	Hull and Bacon: Introduction to Dislocations (1984)  G. Gottstein: Physik. Grundlagen der Materialk. (2001)  N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998)  P. Haupt: Cont. Mechanics and Theory of Materials (2002)		

Course L1123: Welding	Technology
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	<del>-</del>
Cycle	
	<ul> <li>phase transitions, phase diagrams and thermal activated processes</li> <li>fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams</li> </ul>
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
	- 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
Content	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal 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 H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
Literature	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Courses				
<b>Title</b> Numerical Mathematics I (L	0417)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Numerical Mathematics I (L		Recitation Section (small)		3
Module Responsible	Prof. Sabine Le Borne			
Admission Reguirements	None			
Recommended Previous Knowledge	for Tochnomathomaticians	ss (german or english) <b>or</b> Ana	alysis & Line	ear Algebra I +
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas,      repeat convergence statements for the numerical methods.			
	Students are able to			
Skills	<ul> <li>implement, apply and compare numerica</li> <li>justify the convergence behaviour of r solution algorithm,</li> <li>select and execute a suitable solution approximately</li> </ul>	numerical methods with re	spect to th	e problem an
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>work together in heterogeneously compound and background knowledge), explain t practical aspects regarding the implement</li> </ul>	heoretical foundations and		
	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 r</li> </ul>	·		
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Elect General Engineering Science (German program Focus Theoretical Mechanical Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering Compulsory Engineering Compulsory Engineering Compulsory Engineering Compulsory Engineering Compulsory (Compulsory Engineering Compulsory Engineering Compulsory Engineering Compulsory (Compulsory Engineering Compulsory Engineering Compulsory (Compulsory Engineering Compulsory Engineering Compulsory (Compulsory Engineering Compulsory (Compulsory Engineering Compulsory Engineering Compulsory (Compulsory (Co	n, 7 semester): Specialisations ilsory n, 7 semester): Specialisation n, 7 semester): Specialisation n, 7 semester): Specialisations ive Compulsory n, 7 semester): Specialisations	on Mechanic on Biomedic on Mechanic on Mechanic on Mechanic	al Engineering al Engineering al Engineering al Engineering al Engineering al Engineering al Engineering
Assignment for the Following Curricula	Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computationa Electrical Engineering: Core qualification: Electric General Engineering Science (English program General Engineering Science (English program Focus Materials in Engineering Sciences: Computations of Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Computer Science (English program Computer Science (English program Computer Science)	I Mathematics: Elective Com ve Compulsory am, 7 semester): Speciali a, 7 semester): Specialisation alsory a, 7 semester): Specialisation	pulsory sation Com on Mechanic on Biomedic	puter Science al Engineering al Engineering

Focus Biomechanics: 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 Theoretical Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerio	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
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 für Ingenieure und Naturwissenschaftler, Springer</li> </ul>

Course L0418: Numeric	ourse 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. Jens-Peter Zemke	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1009: M	laterial Science Laboratory			
Courses				
Title		Тур	Hrs/wk	СР
Material Science Laboratory	erials Science Laboratory (L1088) r (L1235)	Lecture Practical Course	2 4	2 4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lear	ning results	
Professional Competence				
Knowledge	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			
Examination	Written exam			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson			
	General Engineering Science (German 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	
	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	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 L1235: Materia	Course L1235: Material Science Laboratory		
Тур	Practical Course		
Hrs/wk	4		
СР	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		

Courses				
Courses		T	Han farala	CD.
<b>Title</b> Introduction to Control Syst	ems (L0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements		a and fraguency damain. Lanla		
Recommended Previous Knowledge	Representation of signals and systems in tim	e and frequency domain, Lapiac	e transform	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic syst particular explain properties of first an</li> <li>They can explain the dynamics of simp of frequency response and root locus</li> <li>They can explain the Nyquist stability</li> <li>They can explain the role of the phase</li> <li>They can explain the way a PID coresponse</li> <li>They can explain issues arising who implemented digitally</li> </ul>	d second order systems ble control loops and interpret o criterion and the stability margi margin in analysis and synthes ntroller affects a control loop	lynamic propersions derived for the control in terms of the control in terms o	perties in term rom it. loops f its frequenc
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 jointly s	solve technical problems, and e	xperimental	ly validate thei
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	controller designs Students can obtain information from pro experiment guides) and use it when solving o		, software	documentatior
Autonomy	They can assess their knowledge in weekly o	n-line tests and thereby control	their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6	-		
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German pro	ogram, 7 semester): Speciali	sation Com	puter Science
	Compulsory General Engineering Science (German prog	ram. 7 semester): Snecialisatio	on Bionroce	ss Engineering
	Compulsory			
	General Engineering Science (German pro Compulsory	ogram, 7 semester): Specialis	sation Nava	al Architecture
	General Engineering Science (German pr	ogram, 7 semester): Specia	lisation Civ	il Engineering
	Compulsory General Engineering Science (German proc	ıram. 7 semester): Specialisat	ion Electric	al Engineering
	Compulsory	•		5
	General Engineering Science (German prog Compulsory	ram, 7 semester): Specialisation	on Biomedic	al Engineering
	General Engineering Science (German progr	am, 7 semester): Specialisation	n Energy an	d Enviromenta
	Engineering: Compulsory General Engineering Science (German pro	gram, 7 semester): Specialisa	ation Proces	ss Engineering
	Compulsory General Engineering Science (German progr	ram, 7 semester): Specialisatio	n Mechanic	al Engineering
	Tocherar Engineering Science (German progr	an, / semester, specialisation	i-icciiaiilc	a. Luguiceili

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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	ction to Control Systems
Tvp	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M0730: C	omputer Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L03		Lecture	3	4
Computer Engineering (L03		Recitation Section (small)	1	2
Module Responsible				
Admission Requirements	None			
Recommended	Basic knowledge in electrical engineering			
Previous Knowledge	After taking part successfully, students have rea	ched the following learning	racults	
Professional		eried the following learning	results	
Competence				
Knowledge	This module deals with the foundations of the form the assembly-level programming down to g  Introduction Combinational logic: Gates, Boolean combinational networks Sequential logic: Flip-flops, automata, systematical foundations Computer arithmetic: Integer addition, subspaces of computer architecture: Programm Memories: Memory hierarchies, SRAM, DR Input/output: I/O from the perspective connections, busses  The students perceive computer systems from internal structure and the physical composition	algebra, Boolean functions algebra, Boolean functions tematic hardware design obtraction, multiplication and ming models, MIPS single-cy AM, caches of the CPU, principles of put the architect's perspect	the following ons, hardw I division ycle architect passing data tive, i.e., th	topics:  vare synthesis  ture, pipelining  n, point-to-poin  ey identify the
Skills	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 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	e or in a group and to prese	nt the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	om specific literature and t	o associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lect	cure 56		
Credit points	6			
Examination				
Examination duration and scale	90 minutes, contents of course and labs			
	General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory	an, 7 semester): Specialisation,  on Bioproce sation Nava disation Civ tion Electric on Biomedic n Energy an ation Proces	ss Engineering al Architecture il Engineering cal Engineering d Enviromenta ss Engineering cal 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, 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	ov Engineeving
•	
Тур	Lecture
Hrs/wk	3
СР	4
<b>Workload in Hours</b>	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	
СР	2	
<b>Workload in Hours</b>	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: E	nhanced Fundamentals of M	aterials Science		
Courses				
	eramics and Polymers (L1233) eramics and Polymers (L1234) etals (L1086)	<b>Typ</b> Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	<b>CP</b> 2 1 3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Fundamentals of Materials Science"  Module "Materials Science Laboratory"  Module "Advanced Materials"			
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	and mass transport, microstructure and p technical terms.			
Skills	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.			
Personal Competence				
Social Competence Autonomy	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination				
Examination duration and scale	180 min			
	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, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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			

Course L1233: Enhance	ed Fundamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner
Language	DE/EN
Cycle	SoSe
	1. Einführung  Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von 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) Plastische Formgebung (15 - 25 % Feuchte) Content 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 plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung 6. Elektrische Eigenschaften von Keramiken Ferroelektische Keramiken Piezo-, ferroelektrische Materialeigenschaften Anwendungen Keramische Ionenleiter Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications 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 Press, D. Munz, T. Fett, Ceramics, Springer, 2001 Literature Polymerwerkstoffe Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 € 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: Enhance	ourse L1234: Enhanced Fundamentals: Ceramics and Polymers	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course 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 Materials for hydrogen storage Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism Magnetic materials: applications	
Literature	Vorlesungsskript	

Module M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the import Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Economic Management and to name important definiti. • explain the most important aspects of and aspects of entreprneurial projects. • describe and explain basic business function chain management, organization and human innovation management and marketing. • explain the relevance of planning and decomplished by multiple objectives and uncertainty, and Finance. • state basics from accounting and costing and	larketing and Innovation, nics and Management a ons from the field of Mana goals in Management and ns as production, procure n ressource management cision making in Busines explain some basic me	and also to and the subagement and sement an	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
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 risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence	i			
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture treport on the project     to communicate appropriately and     to cooperate respectfully with their fellow str		oject and w	rite a coherent
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team the</li> <li>to write a report on their project.</li> </ul>	emselves		
Workload in Hours	  Independent Study Time 110, Study Time in Lectur	re 70		
Credit points		-		
Examination	Subject theoretical and practical work			
Examination duration and scale	I Several Written exams diiring the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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>
	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
Literature	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **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 Engin	eering Design II (L0264)	Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Advanced Mechanical Engin Advanced Mechanical Engin		Lecture Recitation Section (large)	2	2 1
		Recitation Section (large)	2	-
Module Responsible  Admission				
Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Competence	After passing the module, students are ab	ole to:		
Knowledge	explain complex working principles and functions of machine elements and of basic elements of fluidics.			
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 techniques</li> </ul>	chnical information in the lectur	e 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			
Examination duration and scale	120			
	General Engineering Science (German pr Systems: Compulsory General Engineering Science (German pr Systems Engineering: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pro Development and Production: Compulsory General Engineering Science (German Theoretical Mechanical Engineering: Com General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German procus Aircraft Systems Engineering: Comp	ogram): Specialisation Mechanical program): Specialisation Mech ilsory program): Specialisation Mech ogram): Specialisation Mechanical / program): Specialisation Mech pulsory rogram, 7 semester): Specialisation	Engineering anical Eng anical Eng Engineering anical Eng	g, Focus Aircraineering, Focuineering, Focus Producineering, Focus

Assignment for the

**Following Curricula** 

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 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

rse L0264: Advance	d Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	
СР	2
<b>Workload in Hours</b>	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	Exercise  • 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> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlaraktuelle 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 Vieweraktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advanced Mechanical Engineering Design II	
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	SoSe
Content	See interlocking course
Literature	See interlocking course

ırse L0262: Advance	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	
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
	Advanced Mechanical Engineering Design I & II  Lecture
Content	Fundamentals of the following machine elements:  Linear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives Gear drives Gear drives Sliding bearings Elements of fluidics  Exercise  Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Belt & chain drives Gear drives Gear drives Figure 3 Crank gears Crank gears Sliding bearings Calculations of hydrostatic systems (fluidics)
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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</li> </ul>
Literature	<ul> <li>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., Springer Vieweraktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

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	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (small)	3	4 2
Module Responsible				
Admission				
Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of sign by the moduls Mathematik 1-3 is expected. Furt series, Fourier transform, Laplace transform) is us	her experience with spectr		
Educational Objectives	After taking part successfully, students have read	thed the following learning r	esults	
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 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 dusing methods of signal and system theory. The important properties such as magnitude and phathe impact of LTI systems on the signal properties.	ey can analyse and desigr ase response, stability, line	n basic syst arity etc T	ems regardir
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information control their level of knowledge during the lectuclicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): Focus Biomechanics: Compulsory General Engineering Science (German program): Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program): Focus Mechatronics: Compulsory General Engineering Science (German program):	Specialisation Computer Sc Specialisation Process Engi Specialisation Bioprocess E : Specialisation Mechanical E Specialisation Biomedical E Specialisation Biomedical E 1, 7 semester): Specialisation, 7 semester): Speci	ience: Compleering: Congineering: Congineering: Environment. Ingineering: Ingineeri	pulsory mpulsory Compulsory al Engeneerin Compulsory Compulsory al Engineerin mputer Science as Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin

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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0432: Signals	and 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 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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1320: S	imulation and Design of Mec	hatronic Systems		
Courses				
Title Typ Hrs/wk CP Simulation and Design of Mechatronic Systems (L1822) Lecture 2 Simulation and Design of Mechatronic Systems (L1823) Recitation Section (large) 1 Simulation and Design of Mechatronic Systems (L1824) Practical Course 1 2		2		
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	LNODA			
Recommended Previous Knowledge		ry and electrical engineering		
<b>Educational Objectives</b>	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	Students are able to describe methods optimization of mechatronic systems.	Students are able to describe methods and calculations for design, modeling, simulation and optimization of mechatronic systems.		simulation and
Skills	Students are able to apply modern algoritl simulate and design simple systems and ir			ney can identify,
Personal Competence				İ
Social Competence		Students are able to work goal-oriented in small mixed groups and present results to target groups.		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 a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula		ogram, 7 semester): Specialisation ulsory ogram, 7 semester): Specialisation Elective Compulsory ogram, 7 semester): Specialisation ogram, 7 semester): Specialisation ulsory ogram, 7 semester): Specialisation ulsory ogram, 7 semester): Specialisation ulsory ogram, 7 semester): Specialisation ulsory craft Systems Engineering: Compulsory craft Systems Engineering: Compulsory coretical Mechanical Engineering:	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic ulsory	cal Engineering, cal Engineering, cal Engineering, cal Engineering, cal Engineering,

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 ® and Simulink®
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung

Course L1823: Simulati	ourse 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

Module M0708: F	lectrical Engineering III: Circuit Theory an	d Transien	ıts	
Produce Provider E	ectical Engineering in circuit fileory an	ia mansien		
Courses				
Title	Тур		Hrs/wk	CP
Circuit Theory (L0566) Circuit Theory (L0567)	Lecture Recitation		3 2	4 2
		Jeecie (Jiliali)		_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and II			
<b>Educational Objectives</b>	After taking part successfully, students have reached the follo	owing learning re	esults	
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating series analysis of linear networks driven by periodic signal analysis of linear networks in time and in frequency domain, a behaviour and the synthesis of passive two-terminal-circuits.	ls. They know t	the methods	for transient
Skills	The students are able to calculate currents and voltages in lir also when driven by periodic signals. They are able to calcul and frequency domain and are able to explain the respectionallyse and to synthesize the frequency behaviour of passive	ate transients ir ive transient be	n electrical o	ircuits in time
Personal Competence  Social Competence	Students work on exercise tasks in small guided groups. The their results within the group.	ey are encourag	ed to prese	nt and discuss
Autonomy	The students are able to find out the required methods Possibilities are given to test their knowledge during the lect tests. This allows them to control independently their educati knowledge to other courses like Electrical Engineering I and M	tures continuous onal objectives.	sly by means	s of short-time
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	150 min			
	General Engineering Science (German program, 7 semester Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester Compulsory Computational Science and Engineering: Specialisation II. Ma Compulsory Computational Science and Engineering: Specialisation Engineering Specialisation Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: E	er): Specialisation  ): Specialisation  er): Specialisation  thematics & Enguering Sciences:	on Electrican Mechanican on Electrican gineering Sci	I Engineering I Engineering, I Engineering

Course L0566: Circuit Theory		
Тур	Lecture	
Hrs/wk	3	
СР	4	
	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle		
	- 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	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) - R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)	
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)	

Course L0567: Circuit Theory	
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: C	omputer Engineering	
Courses		
Title	Typ Hrs/wk CP	
Computer Engineering (L03		
Computer Engineering (L03		
Module Responsible		
Admission Requirements	None	
	Basic knowledge in electrical engineering	
Previous Knowledge	After taking part successfully, students have reached the following learning results	
Professional		
Competence		
Knowledge	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the laye 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 synthesi 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, pipelinine</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> </li> <li>The students perceive computer systems from the architect's perspective, i.e., they identify the</li> </ul>	
Skills	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 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 present the results accordingly.	
,	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Credit points	6	
	Written exam	
Examination duration and scale	90 minutes, contents of course and labs	
	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 Enviroment 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 Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory	

	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, 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

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	
СР	2	
<b>Workload in Hours</b>	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> Introduction to Control Syst	ems (I 0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements	   Representation of signals and system	ms in time and frequency domain, Lapla	co transform	1
Recommended Previous Knowledge		ns in time that requertey domain, Euplo	ce transform	•
Educational Objectives	After taking part successfully, stude	nts 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 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 and frequence response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time arruse 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 the			
	controller designs   Students can obtain information     experiment guides) and use it when	from provided sources (lecture notes solving given problems.	s, software	documentatio
Autonomy	They can assess their knowledge in	weekly on-line tests and thereby contro	l their learnii	ng progress.
	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Examination Examination duration	Written exam			
and scale				
		rman program, 7 semester): Special	isation Com	nputer Scienc
	Compulsory General Engineering Science (Germ	nan program, 7 semester): Specialisati	on Bioproce	ss Engineerin
	Compulsory			
	General Engineering Science (Ger Compulsory	man program, 7 semester): Special	isation Nava	al Architectur
	General Engineering Science (Ge	rman program, 7 semester): Specia	alisation Civ	il Engineerin
	Compulsory General Engineering Science (Gerr	nan program, 7 semester): Specialisa	tion Flectric	al Fnoineerin
	Compulsory	, ,		-
	General Engineering Science (Germ Compulsory	nan program, 7 semester): Specialisati	on Biomedic	cal Engineerin
	General Engineering Science (Germ	an program, 7 semester): Specialisatio	n Energy ar	nd Enviroment
	Engineering: Compulsory General Engineering Science (Ger	man program, 7 semester): Specialis	ation Proce	ss Enaineerin
	Compulsory			
	General Engineering Science (Germ	nan program, 7 semester): Specialisati	on Mechanic	al 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
Тур	Lecture
Hrs/wk	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M0777: S	emiconductor Circuit Desigr	1		
Courses				
Title Semiconductor Circuit Designation Semiconductor Circuit Designation Circuit Circuit Designation Circuit Designation Circuit Circuit Circuit		<b>Typ</b> Lecture Recitation Section (small	Hrs/wk 3	<b>CP</b> 4 2
Module Responsible	Prof. Matthias Kuhl	•		
Admission	1			
Requirements				
Recommended Previous Knowledge	Fundamentals of electrical engineering  Basics of physics, especially semiconduct	or physics		
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence		J		
Knowledge	<ul> <li>Students are able to explain the functionality of different MOS devices in electronic circuits.</li> <li>Students are able to explain how analog circuits functions and where they are applied.</li> <li>Students are able to explain the functionality of fundamental operational amplifiers and thei specifications.</li> <li>Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.</li> <li>Students have knowledge about memory circuits and can explain their functionality and specifications.</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 parameter 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	Students are able work efficiently i     Students working together in si		s and answ	er professional
Autonomy	Students are able to assess their le	evel of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Examination Examination duration	Written exam			
and scale				
Assignment for the Following Curricula				

ırse L0763: Semicor	ductor Circuit Design
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
	Prof. Matthias Kuhl
Language	
Cycle	SoSe
Content	<ul> <li>Repetition Semiconductorphysics and Diodes</li> <li>Functionality and characteristic curve of bipolar transistors</li> <li>Basic circuits with bipolar transistors</li> <li>Functionality and characteristic curve of MOS transistors</li> <li>Basic circuits with MOS transistors for amplifiers</li> <li>Operational amplifiers and their applications</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Basic circuits with MOS transistors for combinational logic</li> <li>Memory circuits</li> <li>Basic circuits with MOS transistors for sequential logic</li> <li>Basic concepts of analog-to-digital and digital-to-analog-converters</li> </ul>
Literature	<ul> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496</li> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN 047170055S</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>

Typ	Recitation Section (small)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	<ul> <li>Basic circuits and characteristic curves of bipolar transistors</li> <li>Basic circuits and characteristic curves of MOS transistors for amplifiers</li> <li>Realization and dimensioning of operational amplifiers</li> <li>Realization of logic functions</li> <li>Basic circuits with MOS transistors for combinational and sequential logic</li> <li>Memory circuits</li> <li>Circuits for analog-to-digital and digital-to-analog converters</li> <li>Design of exemplary circuits</li> </ul>
Literature	<ul> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflag 2012, ISBN 3540428496</li> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISB 047170055S</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berl 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>

Module M0854: M	1athematics IV			
Courses				
Differential Equations 2 (Par Differential Equations 2 (Par Complex Functions (L1038) Complex Functions (L1041) Complex Functions (L1042) Module Responsible		Typ Lecture Recitation Section (small) Recitation Section (large) Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1 2 1	CP 1 1 1 1 1 1
Admission Requirements				
Recommended Previous Knowledge	Mathematics 1 - III			
<b>Educational Objectives</b>	After taking part successfully, students have	e 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 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 ir 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 th can specify open questions precisely</li> <li>Students have developed sufficient priented manner on hard problems.</li> </ul>	and know where to get help in se	olving them	
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	IOU MIN (COMDIEX FUNCTIONS) + OU MIN (DILLE	erential Equations 2)		
Assignment for the	General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering: ( General Engineering Science (German p Compulsory Computer Science: Specialisation Computat Electrical Engineering: Core qualification: Co General Engineering Science (English pro Compulsory General Engineering Science (English pro General Engineering Science (English pro Focus Mechatronics: Compulsory	gram, 7 semester): Specialisation gram, 7 semester): Specialisation Compulsory program, 7 semester): Specialisation ctional Mathematics: Elective Compulsory orgram, 7 semester): Specialisation	on Mechanion Mechanion Mechanion Navapulsory	cal Engineering, cal Engineering, al Architecture: cal Engineering:

Following Curricula	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 II. Mathematics & Engineering Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: 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: Differen	tial 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	Main features of the theory and numerical treatment of partial differential equations  Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1044: Differential Equations 2 (Partial Differential Equations)		
Recitation Section (small)		
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		

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	
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 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	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1041: Complex Functions			
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 L1042: Complex	urse L1042: Complex Functions		
Тур	Recitation Section (large)		
Hrs/wk			
СР			
<b>Workload in Hours</b>	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 M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the impo Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Econom Management and to name important definit • explain the most important aspects of and aspects of entreprneurial projects • describe and explain basic business function chain management, organization and huma innovation management and marketing • explain the relevance of planning and demultiple objectives and uncertainty, and Finance • state basics from accounting and costing and	Marketing and Innovation, nics and Management a ions from the field of Management and goals in Management and ons as production, procure n ressource management cision making in Busines explain some basic me	and also to land the sulagement domain name the ement and so, informations, esp. in sethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
Skills	Students are able to analyse business units with a strategies etc.) and to carry out an Entrepreneursh  analyse Management goals and structure th analyse organisational and staff structures of apply methods for decision making under m analyse production and procurement system analyse and apply basic methods of marketi select and apply basic methods from mathe apply basic methods from accounting, costing	nip project in a team. In pa lem appropriately of companies Jultiple objectives, under u as and Business information ing matical finance to predefin	incertainty a on systems	y are able to  nd under risk
Personal Competence				
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture report on the project     to communicate appropriately and     to cooperate respectfully with their fellow st		roject and w	rite a coherent
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team the</li> <li>to write a report on their project.</li> </ul>	emselves		
Workload in Hours	!  Independent Study Time 110, Study Time in Lectu	re 70		
Credit points				
Examination	Subject theoretical and practical work		-	
Examination duration and scale	iseveral written exams diiring the semester			
and scale	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Compulsory

Energy and Environmental Engineering: Core qualification: 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:

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 Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	ction to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. Kathrin 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **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.

Module M0597: A	dvanced Mechanical Engine	ering 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	CP 2 1 2
	1	Recitation Section (large)	Z	1
Module Responsible  Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Mechanical Engineering Design     Mechanics			
<b>Educational Objectives</b>	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence		alo to:		
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	Students are able to discuss temethods.	chnical information in the lectur	e supporte	ed by activating
Autonomy	<ul> <li>Students are able to independently</li> <li>Students are able to acquire additi e.g. by using the video recordings</li> </ul>	onal knowledge and to recapitulate		
Workload in Hours	Independent Study Time 68, Study Time i	n Lecture 112		
Credit points	6			
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German pr Systems: Compulsory General Engineering Science (German pr Systems Engineering: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German pr Development and Production: Compulsory General Engineering Science (German	rogram): Specialisation Mechanical program): Specialisation Mechalsory program): Specialisation Mechanical ogram): Specialisation Mechanical	Engineerin anical Eng anical Eng Engineerin	g, Focus Aircraf lineering, Focus lineering, Focus g, Focus Produc

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 **Following Curricula** 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

	ed Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	
СР	2
<b>Workload in Hours</b>	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>
	Calculation methods of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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 Viewe aktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advanced Mechanical Engineering Design II		
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

rse L0262: Advance	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	
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
	Advanced Mechanical Engineering Design I & II  Lecture
Content	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  Elements of fluidics   Exercise  Calculation methods of the following machine elements:  Linear rolling bearings  Axes & shafts  Clutches & brakes  Belt & chain drives  Gear drives  Gear drives  Epicyclic gears  Crank gears  Sliding bearings
	Calculations of hydrostatic systems (fluidics)  Dubbel Tackarbush für den Masshinarbay Crata K. H. Faldbusen J. (Hann.). Carinasa Vada
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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, Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe aktuelle Auflage.</li> </ul>
	Sowie weitere Bücher zu speziellen Themen

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	

Module M0725: P	roduction Engineering			
Courses				
Title Production Engineering I (LC Production Engineering I (LC Production Engineering II (L	0612) 0610)	Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	CP 2 1 2
Production Engineering II (L	· •	Recitation Section (large)	1	1
Module Responsible	i			
Admission Requirements	None			
Recommended Previous Knowledge	no course assessments required internship recommended			
<b>Educational Objectives</b>	After taking part successfully, studer	nts have reached the following learning	results	
Professional Competence				
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> </ul>			
Skills	Students are able to  • select manufacturing processes in accordance with the requirements.  • design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.  • assess components in terms of their production-oriented construction.			
Personal Competence  Social Competence	Students are able to  • develop solutions in a production environment with qualified personnel at technical level and			
Autonomy	Students are able to  • interpret independently the manufacturing process.  • assess own strengths and weaknesses in general.  • assess their learning progress and define gaps to be improved.  • assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study T	ime in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory 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 Mechanical Engineering: Core qualification: Compulsory			

Course L0608: Product	ion 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	<u>WiSe</u>
Content	Introduction to Machining Technology     Geometrically defined machining (Turning, milling, drilling, broaching, planning)
Literature	Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007  Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004  Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008  Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008  Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)  Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006  Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996  Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)

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: Producti	ion 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	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: Producti	ourse 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		

Module M0596: A	dvanced Mechanical Design Proje	ct		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Desig	n Project (L0266)	Project-/problem-based Learning	4	6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Mechanical Engineering: Design</li><li>Advanced Mechanical Engineering Design</li></ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	After passing the module, students are able to:			
Knowledge	<ul> <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	After passing the module, students are able to:  analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, use methods to design and solve engineering design tasks systematically and solution-oriented, create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail.			
Personal Competence	After passing the module, students are able to:			
Social Competence				
Autonomy	After passing the module, students are able to:  • independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,  • to independently solve problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
	Written exam			
Examination duration and scale	180			
Assignment for the Following Curricula	General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Product Development and Production: Com General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compul General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Product Development and Production: Com General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Compulmechanical Engineeri	7 semester): Specialisati pulsory 7 semester): Specialisati ulsory 7 semester): Specialisati valsory 7 semester): Specialisati pulsory 7 semester): Specialisati valsory 7 semester): Specialisati valsory	on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineering, cal Engineering, cal Engineering, cal Engineering,

Course L0266: Advance	d Mechanical Design Project
Тур	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	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.  • Getriebekonstruktion in Einzelarbeit  • Erarbeitung von Lösungsprinzipien  • Berechnung von Maschinenelementen  • Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten  • Erstellung einer ausführlichen Dokumentation  • Lösungsfindung  • Methodische Erarbeitung von prinzipiellen Lösungskonzepten  • Erstellen einer Dokumentation
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 M0726: P	roduction Technology			
Courses				
Title Fundamentals of Machine Tools (L0689) Fundamentals of Machine Tools (L1992) Forming and Cutting Technology (L0613) Forming and Cutting Technology (L0614)		Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	CP 2 1 2
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge	without major course assessment internship recommended Previous knowledge in mathematics, mechanics ar	nd electrical engineering		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	<ul> <li>explain the basics of chip formation and mechanisms and models of machining.</li> <li>explain methods and parameters for design and analysis of metal forming, machining processes and tools.</li> </ul>			
Skills	<ul> <li>select tool geometry, cutting materials, process parameters and appropriate measuring 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 and milling.</li> <li>assess the quality of a machine tools and to detect weak points.</li> </ul>			
Personal Competence				j
Social Competence	Students are able to  develop solutions in a production environr represent decisions.	nent with qualified persor	nnel at tech	nical level and
Autonomy	Students are able to  • interpret independently cutting processes.  • create independently NC programs.  • select independently machine tools by reference to appropriate requirements.  • assess own strengths and weaknesses in general.  • assess their learning progress and define gaps to be improved.  • assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	2 84		
Credit points				
	Written exam 180 min			
Assignment for the Following Curricula	II ocas i rodact Developinent ana i rodaction. Comp	oulsory 7 semester): Specialisatio oulsory velopment and Production	n Mechanic	al Engineering,

Course L0689: Fundam	entals of Machine Tools					
	Lecture					
Hrs/wk						
СР	2					
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28					
	Prof. Thorsten Schüppstuhl					
Language						
Cycle	MISE Ferminology 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						
	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: Fundam	ourse 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			
	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Wolfgang Hintze			
Language				
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 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 MU/30: C	Computer Engineering			
Courses				
Title	Typ Hrs/wk CP			
Computer Engineering (L03				
Computer Engineering (L03				
Module Responsible				
Admission Requirements	INONE			
	Basic knowledge in electrical engineering			
Previous Knowledge				
Professional	After taking part successfully, students have reached the following learning results			
Competence				
Knowledge	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layer 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-poir 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, holighly specific and individual computers can be built based on a collection of few and simple</li> </ul>			
Skills	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 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 present the results accordingly.			
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
	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 Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory			

	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  Control Engineering Science (English program 7 computer Science)
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

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: Compute	urse L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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					
Courses					
<b>Title</b> Introduction to Control Syst	ems (10654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4	
Introduction to Control Syst		Recitation Section (small)		2	
Module Responsible	Prof. Herbert Werner				
Admission					
Requirements					
Recommended Previous Knowledge	Representation of signals and systems in ti	me and frequency domain, Lapia	ce transform	I	
Educational Objectives	After taking part successfully, students hav	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 and frequence response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time an 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 jointly	y solve technical problems, and e	xperimental	ly validate the	
,	controller designs Students can obtain information from perperiment guides) and use it when solving		, software	documentation	
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.				
Workload in Hours	I Independent Study Time 124, Study Time i	n Lecture 56			
Credit points	!				
Examination	Written exam				
Examination duration and scale					
anu scale	General Engineering Science (German	program, 7 semester): Special	isation Com	nputer Science	
	Compulsory	ogram 7 samastar). Chasialisati	an Diantasa	.a. Fnainearine	
	General Engineering Science (German pro Compulsory				
	General Engineering Science (German	program, 7 semester): Speciali	sation Nava	al Architecture	
	Compulsory General Engineering Science (German	program, 7 semester): Specia	lisation Civ	ril Engineering	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering				
	Compulsory				
	General Engineering Science (German pro Compulsory	ogram, 7 semester): Specialisati	on Biomedic	cal Engineering	
	General Engineering Science (German pro	gram, 7 semester): Specialisatio	n Energy ar	nd Enviromenta	
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering			ss Engineering	
	Compulsory				
	General Engineering Science (German pro	ogram, 7 semester): Specialisation	ווכ Mechanic	aı 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, 7 semester): Specialisation Computer Science:

## Assignment for the Following Curricula

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

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: Introduc	tion 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	/iSe					
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 Root locus design of PID controllers  Frequency response techniques					
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>					

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	

Module M0599: II	ntegrated Product Development a	nd Lightweight D	esign		
Courses					
Title		<b>Typ</b> Project-/problem-based	Hrs/wk	СР	
CAE-Team Project (L0271)  Development of Lightweigh  Integrated Product Develop		Learning Lecture Lecture	2 2	2 2 2	
Module Responsible		200141.0			
Admission					
Requirements					
	Advanced Knowledge about engineering design:				
Recommended	Fundamentals of Mechanical Engineering Design				
Previous Knowledge	Mechanical Engineering: Design				
	Advanced Mechanical Engineering Design				
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results		
Professional Competence					
	After completing the module, students are capabl	e of:			
Knowledge	<ul> <li>explaining the functional principle of 3D-CA</li> </ul>	AD-Systems, PDM- and FEN	1-Systems		
,	describing the interaction of the different C	AE-Systems in the produc	t developme	nt process	
	After completing the module, students are able to	):			
	, , , , , , , , , , , , , , , , , , ,				
Skills	esired requirements such as with shared workload				
Personal Competence					
	After completing the module, students are able to				
Social Competence	<ul> <li>To develop a project plan and allocate work appropriate work packages in the framework of group discussions</li> <li>Present project results as a team for instance in a presentation</li> </ul>				
	Students are capable of:				
Autonomy	<ul> <li>independently adapt to a CAE-Tool and complete a given practical task with it</li> </ul>				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84			
Credit points	6				
	Written exam				
Examination duration and scale					
	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 Product Development and Production: 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 Product Development and Production: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory				

Course L0271: CAE-Team Project			
Тур	Project-/problem-based Learning		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
	<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	<u>-</u>		

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			
СР	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>		

Module M1005: E	nhanced Fundamentals of Ma	aterials Science		
Courses				
	eramics and Polymers (L1233) eramics and Polymers (L1234) etals (L1086)	<b>Typ</b> Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	<b>CP</b> 2 1 3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
Recommended Previous Knowledge		e"		
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students hav	ve reached the following learning	results	
Professional Competence	The students are able to give an enhanced	l overview over the following topic	S	
Knowledge	in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, elect and mass transport, microstructure and phase diagrams. They are capable to explain the correspoetechnical terms.			
Skills	The students are able to apply the apmentioned subjects.	propriate physical and chemica	I methods f	for the abov
Personal Competence				
Social Competence Autonomy	The students are capable to understand in and polymers. They should be able to crita			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German procus Materials in Engineering Sciences: Comeral Engineering Science (German procus Product Development and Productio General Engineering Science (English procus Materials in Engineering Sciences: Comeral Engineering Science (English procus Product Development and Productio Mechanical Engineering: Specialisation Matechnomathematics: Specialisation III. Engineering Science (IIII. Engineering)	compulsory ogram, 7 semester): Specialisation: n: Compulsory ogram, 7 semester): Specialisation compulsory ogram, 7 semester): Specialisation: n: Compulsory terials in Engineering Sciences: Co	on Mechanic on Mechanic on Mechanic ompulsory	cal Engineering

Course L1233: Enhanced Fundamentals: Ceramics and Polymers				
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner			
Language	DE/EN			
Cycle	SoSe			
	1. Einführung  Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von 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) Plastische Formgebung (15 - 25 % Feuchte) Content 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 plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung 6. Elektrische Eigenschaften von Keramiken Ferroelektische Keramiken Piezo-, ferroelektrische Materialeigenschaften Anwendungen Keramische Ionenleiter Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications 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 Press, D. Munz, T. Fett, Ceramics, Springer, 2001 Literature Polymerwerkstoffe Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 € 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 €

urse 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. Robert Meißner		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course 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	<ul> <li>Enhanced Fundamentals of Metals:</li> <li>Introduction to phenomenological thermodynamics</li> <li>Elasticity</li> <li>Thermal materials behavior (heat capacity, thermal expansion)</li> <li>Conductors, semiconductors, isolators: conduction mechanisms and band structure</li> <li>Superconductors</li> <li>Dry corrosion</li> <li>Electrochemistry in the material sciences</li> <li>Wet corrosion</li> <li>Alloy corrosion</li> <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: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the important Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Econom Management and to name important definiti • explain the most important aspects of and aspects of entreprneurial projects • describe and explain basic business function chain management, organization and human innovation management and marketing • explain the relevance of planning and decomplete multiple objectives and uncertainty, and Finance • state basics from accounting and costing and	larketing and Innovation, nics and Management a ons from the field of Mana goals in Management and ns as production, procure n ressource management cision making in Busines explain some basic me	and also to land the sulagement domain the ement and so, information so, esp. in sethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
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 risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence				
Social Competence	Students are able to  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherent			
	Students are able to			
Autonomy	<ul><li>work in a team and to organize the team the</li><li>to write a report on their project.</li></ul>	emselves		
Workload in Hours	  Independent Study Time 110, Study Time in Lectur	re 70		
Credit points				
Examination	Subject theoretical and practical work			
Examination duration and scale	I Several Written exams diiring the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

Assignment for the

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: 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:

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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

## **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.

Module M0597: A	dvanced Mechanical Engin	eering Design		
Courses				
Title Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin	eering Design II (L0265)	<b>Typ</b> Lecture Recitation Section (large) Lecture	Hrs/wk 2 2 2	<b>CP</b> 2 1 2
Advanced Mechanical Engin	eering Design I (L0263)	Recitation Section (large)	2	1
Module Responsible				
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>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 in skills),</li> </ul>	ations of covered machine elements, the module to new requirements a al drawings and schematic sketches,	nd tasks (μ	oroblem solving
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy		ntly deepen their acquired knowledge litional knowledge and to recapitulate gs of the lectures.		
Workload in Hours	Independent Study Time 68, Study Tim	e in Lecture 112		
Credit points				
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German Systems: Compulsory General Engineering Science (German Systems Engineering: Compulsory General Engineering Science (Germ Materials in Engineering Sciences: Com General Engineering Science (Germ Mechatronics: Compulsory General Engineering Science (German Development and Production: Compuls General Engineering Science (Germ Theoretical Mechanical Engineering: Co	program): Specialisation Mechanical an program): Specialisation Mechanical program): Specialisation Mechanical program): Specialisation Mechanical ory (an program): Specialisation Mechanical ory (an program): Specialisation Mechanical program): Specialisation Mechanical	Engineering anical Engi anical Engi Engineering	g, Focus Aircrafineering, Focus

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 **Following Curricula** 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,

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

Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Focus Theoretical Mechanical Engineering: Compulsory

Focus Biomechanics: Compulsory

ırse L0264: Advance	ed Mechanical Engineering Design II			
Тур	Lecture			
Hrs/wk				
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	SoSe			
	Advanced Mechanical Engineering Design I & II  Lecture			
Content	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  Elements of fluidics   Exercise  Calculation methods of the following machine elements:  Linear rolling bearings  Axes & shafts  Clutches & brakes  Belt & chain drives  Gear drives  Gear drives  Epicyclic gears  Crank gears  Cladulations of hydrostatic systems (fluidics)			
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlaaktuelle 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, Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweraktuelle Auflage.</li> </ul>			
	Sowie weitere Bücher zu speziellen Themen			

Course L0265: Advanced Mechanical Engineering Design II		
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Hrs/wk CP Workload in Hours			
CP Workload in Hours Lecturer	2 Independent Study Time 32, Study Time in Lecture 28		
Workload in Hours Lecturer	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		
Content	Fundamentals of the following machine elements:  Linear rolling bearings  Axes & shafts  Seals  Clutches & brakes  Belt & chain drives  Gear drives  Ficyclic gears  Crank drives  Sliding bearings  Elements of fluidics   Exercise  Calculation methods of the following machine elements:  Linear rolling bearings  Axes & shafts  Clutches & brakes  Belt & chain drives  Belt & chain drives  Gear drives  Epicyclic gears  Crank gears  Sliding bearings  Calculations of hydrostatic systems (fluidics)		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla 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, International Control of the Control of th</li></ul>		
	<ul> <li>Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe aktuelle Auflage.</li> </ul> Sowie weitere Bücher zu speziellen Themen		

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	Typ Hrs/wk CP					
Signals and Systems (L0432						
Signals and Systems (L0433						
Module Responsible						
Admission Requirements						
	Mathematics 1-3					
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covere by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourie series, Fourier transform, Laplace transform) is useful but not required.					
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional						
Competence						
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 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 assess the impact of LTI systems on the signal properties in time and frequency domain.					
Personal Competence						
Social Competence	The students can jointly solve specific problems.					
Autonomy	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 110, Study Time in Lecture 70					
Credit points	6					
Examination	Written exam					
Examination duration and scale	90 min					
	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 Civil- and Enviromental Engeneerin 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory 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 Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechanical Engineering Science (German program, 7 semester): Specialisation Mecha					
Assignment for the	Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: 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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals	and Systems			
Тур	Lecture			
Hrs/wk	3			
СР				
	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 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 (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1320: S	imulation and Design of Me	chatronic Systems				
Courses						
Title		Тур	Hrs/wk	СР		
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2	2		
Simulation and Design of Mechatronic Systems (L1823)  Recitation			1	2		
Simulation and Design of Mo	echatronic Systems (L1824)	Practical Course	1	2		
Module Responsible						
Admission Requirements	None					
Recommended Previous Knowledge	Fundatmentals of mechanics, control the	eory and electrical engineering				
<b>Educational Objectives</b>	After taking part successfully, students h	nave reached the following learning	results			
Professional Competence						
Knowledge	Students are able to describe methods and calculations for design, modeling, simulation and optimization of mechatronic systems.					
Skills	Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulate and design simple systems and implement those in laboratory conditions.					
Personal Competence						
_	Ctudents are able to work goal estanted	in small mixed groups and present r	esults to tar	get groups.		
	Students are able to recognize and impr	Students are able to recognize and improve knowledge deficits independently.				
Autonomy	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.					
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56				
Credit points	6					
	Written exam					
Examination duration and scale	90 min					
Assignment for the Following Curricula	General Engineering Science (German Focus Mechatronics: Compulsory General Engineering Science (German Focus Aircraft Systems Engineering: Con General Engineering Science (German Focus Theoretical Mechanical Engineerin General Engineering Science (English Focus Mechatronics: Compulsory General Engineering Science (English Focus Aircraft Systems Engineering: Con General Engineering Science (English Focus Theoretical Mechanical Engineering: Specialisation Amechanical Engineering: Specialisation Mechanical Engineering: Specialisation Mechanical Engineering: Specialisation Techanical Engineering Specialisation Techanical Engineering Speci	program, 7 semester): Specialisation pulsory program, 7 semester): Specialisation g: Elective Compulsory program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation pulsory program, 7 semester): Specialisation g: Elective Compulsory Aircraft Systems Engineering: Compulsory Theoretical Mechanical Engineering: Theoretical Mechanical Engineering:	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic ulsory	cal Engineering, cal Engineering, cal Engineering, cal Engineering, cal Engineering,		

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 ® and Simulink®		
Literature	Skript zur Veranstaltung Weitere Literatur in der Veranstaltung		

ourse 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		

Module M0684: H	eat Transfer				
Courses					
<b>Title</b> Heat Transfer (L0458) Heat Transfer (L0459)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2	
Module Responsible	Dr. Andreas Moschallski				
Admission Requirements	None				
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics	5			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning	results		
Professional Competence					
	The students are able to				
	- describe the different physical mechanism of Hea	t Transfer,			
Knowledge	- explain the technical terms,				
	- to analyse comlex heat transfer processes in a cri	itical way.			
	The students are able to				
	- understand the physics of Heat Transfer,				
Skills	- calculate and evaluate complex Heat Transfer processes,				
	- solve excersises self-consistent and in small grou	ps.			
Personal Competence					
Social Competence	The students are able to discuss in small groups ar	nd develop an approach.			
Autonomy	The students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchange with other students is given.				
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70			
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective 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 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 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	

Module M0596: A	dvanced Mechanical Design Proje	ct		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Desig	n Project (L0266)	Project-/problem-based Learning	4	6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reach	hed the following learning	results	
Professional Competence				
Knowledge	express the procedure for systematically have complex design tasks.	combination possibilities, n and manufacturing,		
Skills	After passing the module, students are able to:  analyze complex tasks and develop principle convert principle solutions into a detailed described use methods to design and solve engineering create a technical documentation including functions of the system, document calculations of selected machine	esign, ng design tasks systemati g all necessary technical	cally and sol drawings to	ution-oriented, understand the
Personal Competence	:			
Social Competence	After passing the module, students are able to:  • present and discuss solutions and technical  • reflect the own results in the work groups o			
Autonomy	After passing the module, students are able to:  independently solve complex design project knowledge and selecting appropriate methods to independently solve problems.		nselves, acqu	uiring necessary
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
	Written exam			
Examination duration and scale	180			
Assignment for the Following Curricula	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 Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): 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 Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory			

Course L0266: Advance	d Mechanical Design Project			
Тур	Project-/problem-based Learning			
Hrs/wk				
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	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.  • Getriebekonstruktion in Einzelarbeit  • Erarbeitung von Lösungsprinzipien  • Berechnung von Maschinenelementen  • Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten  • Erstellung einer ausführlichen Dokumentation  • Lösungsfindung  • Methodische Erarbeitung von prinzipiellen Lösungskonzepten  • Erstellen einer Dokumentation			
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 M0730: C	Computer Engineering		
Courses			
Title	Typ Hrs/wk CP		
Computer Engineering (L03			
Computer Engineering (L03			
Module Responsible			
Admission Requirements	INONE		
	Basic knowledge in electrical engineering		
Previous Knowledge	After taking part successfully, students have reached the following learning results		
Professional			
Competence			
Knowledge	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layer 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-poin connections, busses</li> </ul> </li> <li>The students perceive computer systems from the architect's perspective, i.e., they identify the</li> </ul>		
Skills	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 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 present the results accordingly.		
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
	Written exam		
Examination duration and scale	90 minutes, contents of course and labs		
	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 Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering		

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	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, 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
	recimonational specialisation in mioritatics. Elective compaisory

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		
СР	2		
<b>Workload in Hours</b>	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				
Courses		<b>T</b>	H /l-	CD.
<b>Title</b> Introduction to Control Syst	ems (L0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission				
Requirements				
Recommended Previous Knowledge	Representation of signals and systems in time	and frequency domain, Laplac	ce transform	ı
Educational Objectives	After taking part successfully, students have re	eached 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 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 and frequence response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time arruse 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 so	lve technical problems, and e	xperimental	ly validate the
cona. competence	controller designs Students can obtain information from proviexperiment guides) and use it when solving given		, software	documentation
Autonomy	They can assess their knowledge in weekly on-	line tests and thereby control	their learnir	ng progress.
Mr. 21 11	Ladamada Guda Tillada Guda Tillada	above EC		
Workload in Hours  Credit points	Independent Study Time 124, Study Time in Le	ecture 56		
Examination				
Examination duration and scale				
	General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory General Engineering Science (German programulsory	m, 7 semester): Specialisation ram, on Bioproces sation Nava lisation Civ tion Electric on Biomedic n Energy an	ss Engineering al Architectur il Engineering al Engineering al Engineering de Enviroment as 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
Typ	Lecture
Hrs/wk	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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	

Module M0725: P	roduction Engineering			
Courses				
Title Production Engineering I (L0608) Production Engineering I (L0612) Production Engineering II (L0610)		Typ Lecture Recitation Section (large Lecture	2	CP 2 1 2
Production Engineering II (L	•	Recitation Section (large	) 1	1
Module Responsible Admission	l			
Requirements	Notice			
Recommended Previous Knowledge	no course assessments required internship recommended			
<b>Educational Objectives</b>	After taking part successfully, student	s have reached the following learning	g results	
Professional Competence				
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> </ul>			
Skills	Students are able to  • select manufacturing processes in accordance with the requirements.  • design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.  • assess components in terms of their production-oriented construction.			
Personal Competence  Social Competence	Students are able to  • develop solutions in a production environment with qualified personnel at technical level and			
Autonomy	Students are able to  • interpret independently the manufacturing process.  • assess own strengths and weaknesses in general.  • assess their learning progress and define gaps to be improved.  • assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study Tir	me in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory 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			

Course L0608: Product	ion 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	<u>WiSe</u>
Content	Introduction to Machining Technology     Geometrically defined machining (Turning, milling, drilling, broaching, planning)
Literature	Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007  Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004  Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008  Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008  Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)  Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006  Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996  Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)

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: Producti	ion 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>
	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 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	

Module M0662: N	lumerical Mathematics I			
Courses				
Title Numerical Mathematics I (Li	0417)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Studen for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	its (german or english) <b>or</b> An	alysis & Line	ear Algebra I +
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional				
Competence	 			
	Students are able to			
Knowledge	<ul> <li>name numerical methods for interpolar problems, nonlinear root finding problem</li> <li>repeat convergence statements for the nexplain aspects for the practical execution and storage complexitx.</li> </ul>	ns and to explain their core id numerical methods,	eas,	
	Students are able to			
Skills	<ul> <li>implement, apply and compare numerical</li> <li>justify the convergence behaviour of solution algorithm,</li> <li>select and execute a suitable solution application.</li> </ul>	numerical methods with re	spect to th	e problem and
Personal Competence				
<b>,</b>	Students are able to			
Social Competence	<ul> <li>work together in heterogeneously comp and background knowledge), explain practical aspects regarding the implement</li> </ul>	theoretical foundations and		
	Students are capable			
Autonomy	to assess whether the supporting the individually or in a team,     to assess their individual progess and, if	·		
Workload in Hours	Independent Study Time 124, Study Time in Lec	cture 56		
Credit points				
	Written exam			
Examination duration	90 minutes			
and scale	General Engineering Science (German prog Compulsory General Engineering Science (German prograr Focus Materials in Engineering Sciences: Compu General Engineering Science (German program	m, 7 semester): Specialisatio	on Mechanic	cal Engineering
	Compulsory General Engineering Science (German prograr Focus Biomechanics: Compulsory General Engineering Science (German prograr Focus Theoretical Mechanical Engineering: Elec General Engineering Science (German prograr Focus Theoretical Mechanical Engineering: Com Bioprocess Engineering: Specialisation A - Gene Computer Science: Specialisation Computationa Electrical Engineering: Core qualification: Electi	m, 7 semester): Specialisation etive Compulsory m, 7 semester): Specialisation et al Bioprocess Engineering: Eal Mathematics: Elective Com	on Mechanic on Mechanic Elective Com	cal Engineering
Assignment for the Following Curricula	General Engineering Science (English progr Compulsory General Engineering Science (English progran Focus Materials in Engineering Sciences: Compu General Engineering Science (English progran Compulsory General Engineering Science (English progran	ram, 7 semester): Speciali n, 7 semester): Specialisatio ulsory n, 7 semester): Specialisatio	on Mechanic	al Engineering

Focus Biomechanics: 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 Theoretical Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerio	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
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 für Ingenieure und Naturwissenschaftler, Springer</li> </ul>

Course 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. Jens-Peter Zemke	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0854: M	1athematics IV			
Courses				
Differential Equations 2 (Par		Typ Lecture Recitation Section (sma Recitation Section (larg Lecture Recitation Section (sma Recitation Section (larg	e) 1 2 all) 1	CP 1 1 1 1 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learn	ng results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concappropriate examples.</li> <li>Students can discuss logical confillustrating these connections with the theorem in the strategies and can be strategied.</li> </ul>	nections between these con the help of examples.	•	lain them using are capable of
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</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 language.</li> <li>In doing so, they can communicate partners. Moreover, they can design peers.</li> </ul>	e new concepts according to	the needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking to can specify open questions precisel</li> <li>Students have developed sufficient oriented manner on hard problems.</li> </ul>	y and know where to get help it persistence to be able to wo	n solving them	
Workload in Hours	Independent Study Time 68, Study Time in	n Lecture 112		
Credit points				
-	Written exam			
Examination duration and scale		ferential Equations 2)		
Assignment for the	General Engineering Science (German prompulsory General Engineering Science (German procus Mechatronics: Compulsory General Engineering Science (German procus Theoretical Mechanical Engineering General Engineering Science (German Compulsory Computer Science: Specialisation Computer Identical Engineering: Core qualification: General Engineering Science (English prompulsory General Engineering Science (English profocus Mechatronics: Compulsory	rogram, 7 semester): Specialis rogram, 7 semester): Specialis : Compulsory program, 7 semester): Specialis ational Mathematics: Elective Compulsory rogram, 7 semester): Special	cation Mechanication Mechanication Nav Compulsory Sation Electric	cal Engineering, cal Engineering, al Architecture: cal Engineering:

Following Curricula General Engineering Science (English program, 7 semester): Specialisa	ition Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Speci	alisation Naval Architecture:
Compulsory	
Computational Science and Engineering: Specialisation II. Mathematics &	Engineering Science: Elective
Compulsory	
Computational Science and Engineering: Specialisation Computer Science	: Elective Compulsory
Computational Science and Engineering: Specialisation Engineering Scien	ces: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineerin	g: Compulsory
Mechanical Engineering: Specialisation Mechatronics: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Cou	rse Core Studies: Flective
Compulsory	13c core studies. Elective
Compaisory	

Course L1043: Differen	tial 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	Main features of the theory and numerical treatment of partial differential equations  Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

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	
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	Typ Lecture		
Hrs/wk			
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	Main features of complex analysis  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation		
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html		

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		

Course L1042: Complex Functions		
Тур	Recitation Section (large)	
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	

Courses				
Title		Typ	Hrs/wk	CP
Management Tutorial (L088 Introduction to Managemen		Recitation Section (large) Lecture	2 3	3 3
Module Responsible	Prof. Christoph Ihl			
Admississ	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
<b>Educational Objectives</b>	After taking part successfully, students have reacl	hed the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the importance Management, from Planning and Organisation to It Controlling. In particular they are able to  • explain the differences between Economy Management and to name important definite explain the most important aspects of and aspects of entreprneurial projects edescribe and explain basic business function chain management, organization and human innovation management and marketing explain the relevance of planning and demultiple objectives and uncertainty, and Finance estate basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting and costing and destance of the state basics from accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounting accounti	Marketing and Innovation, mics and Management at tions from the field of Management and goals in Management and ons as production, procure an ressource management ecision making in Busines I explain some basic me	and also to and the su agement d name the ement and s , information s, esp. in s ethods from	b-disciplines imost importal ourcing, supply managementituations under
Skills	Students are able to analyse business units with strategies etc.) and to carry out an Entrepreneurs  analyse Management goals and structure the analyse organisational and staff structures apply methods for decision making under nanalyse production and procurement system analyse and apply basic methods of market select and apply basic methods from mather apply basic methods from mather apply basic methods from accounting, costi	hip project in a team. In pa nem appropriately of companies nultiple objectives, under u ms and Business information ting ematical finance to predefi	nticular, the incertainty a on systems ned problem	y are able to nd under risk
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a correport on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			rite a coherei
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team th</li> <li>to write a report on their project.</li> </ul>	nemselves		
		70		
Workload in Hours  Credit points	Independent Study Time 110, Study Time in Lectu	ire /U		
•	Subject theoretical and practical work			
	several written exams during the semester			
and scale	General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	n, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialism, 7 semester): Specialism, 7 semester): Specialism, 7 semester): Specialism,	ation Proces on Biomedic sation Nava sation Com	ss Engineering al Engineering al Architectur puter Science

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

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

Following Curricula 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 Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	ction to Management		
Тур	Lecture		
Hrs/wk	3		
СР	3		
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer			
Language			
Cycle	WiSe/SoSe		
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

## **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: F	undamentals of Materials Science			
Courses				
Title Fundamentals of Materials 5 Fundamentals of Materials 5	Typ Lecture	Hrs/wk	<b>CP</b> 2	
Composites) (L0506)	cs of Materials Science (L1095)	Lecture 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	ned the following learning	results	
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and call describe this knowledge comprehensively. Fundamental knowledge here means specifically the issue 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 call 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 phenomena back to the underlying physical and chemical law of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, an stiffness, chemical properties such as corrosion resistance, and to phase transformations such a solidification, precipitation, or melting. The students can explain the relation between processin conditions and the materials microstructure, and they can account for the impact of microstructure of the material's behavior.			
Personal Competence				
Social Competence	! !			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination Examination duration and scale				
	General Engineering Science (German program): Compulsory General Engineering Science (German program): S General Engineering Science (German program): S General Engineering Science (German program): S General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory	Specialisation Mechanical Especialisation Biomedical Especialisation Naval Archite 7 semester): Specialisation 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation,	Engineering: Engineering: ecture: Com on Mechanic on Biomedic sation Nava	Compulsory Compulsory pulsory cal Engineering cal Engineering

Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental 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 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 Environmental
	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
	reclinomathematics. Specialisation III. Engineering Science: Elective Compulsory

Course L1085: Fundamentals of Materials Science I			
Typ Lecture			
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer Prof. Jörg Weißmüller			
<b>Language</b> DE			
<b>Cycle</b> WiSe			
Content			
	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)			
<b>Typ</b> Lecture			
Hrs/wk 2			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Lecturer Prof. Bodo Fiedler, Prof. Gerold Schneider		
<b>Language</b> DE			
Cycle SoSe			
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe		
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7		

Course L1095: Physical	and Chemical Basics of Materials Science
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
<ul> <li>Motivation: "Atoms in Mechanical Engineering?"</li> <li>Basics: Force and Energy</li> <li>The electromagnetic Interaction</li> <li>"Detour": Mathematics (complex e-funktion etc.)</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 semiconductors, hybrid systems)</li> </ul>	
Literature	<ul> <li>Für den Elektromagnetismus:         <ul> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter</li> </ul> </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 M0730: C	omputer Engineering			
Courses				
Title Computer Engineering (L03 Computer Engineering (L03		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge			nation's marks	
<b>Educational Objectives</b>	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the from the assembly-level programming down to gates. The module includes the following topics:  • Introduction  • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synt combinational networks  • Sequential logic: Flip floor, automata, systematic hardware decign.		topics:  are synthesis,  ure, pipelining  point-to-point	
Skills	The students perceive computer systems fror internal structure and the physical composition highly specific and individual computers can components. They are able to distinguish betw today's computing systems - from gates and circ After successful completion of the module, th between a physical computer system and the understand the consequences that the executio layers from the assembly language down to g impact that these low abstraction levels have feasible options.	of computer systems. The be built based on a coll een and to explain the diff uits up to complete process e students are able to jude software executed on it n of software has on the hates. This way, they will be	students car ection of fe erent abstra ors. dge the inte In particu ardware-cent e enabled to	n analyze, how w and simple ction layers of rdependencies lar, they shal cric abstraction of evaluate the
Personal Competence				
	Students are able to solve similar problems alone	e or in a group and to prese	nt the results	accordingly.
Autonomy	Students are able to acquire new knowledge frow with other classes.	om specific literature and to	o associate t	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	<u> </u>			
Examination	Written exam			
Examination duration and scale	190 minutes contents of course and lans			
	General Engineering Science (German program): General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	am, 7 semester): Speciali , 7 semester): Specialisation am, 7 semester): Specialisam, 7 semester): Specialisam, 7 semester): Specialisat	sation Componessisation Nava Ilisation Civi	s Engineering I Architecture I Engineering al Engineering

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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:

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

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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

Typ Hrs/wk CP Signals and Systems (L0432) Signals and Systems (L0432) Module Responsible   Admission Requirements  Mathematics 1-3  Recommended   Previous Knowledge   Prof. Gerhard Bauch   Admission Requirements  Mathematics 1-3  Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mathematics 1-3  Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mathematics 1-3  Recommended   Previous Knowledge   Prof. Gerhard Bauch   Mathematics 1-3  The modul is an introduction to the theory of signals and systems. Good knowledge in maths as coven by the moduls Mathematic 1-3 is expected. Further experience with spectral transformations (Fourisseries, Fourier transform), Laplace transform) is useful but not required.  Beducational Objectives   Professional   Competence   Nanoledge   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Recommended   Previous Knowledge   Recommended   Previous Knowledge   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Recommended   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Recommended   Recommended   Recommended   Recommended   Previous Knowledge   Prof. Gerhard Bauch   Recommended   Courses					
Signals and Systems (10432)  Module Responsible   Prof. Gerhard Bauch   Rectation Section (small)   2   2   2    Module Responsible   Prof. Gerhard Bauch   Rectation Section (small)   2   2   2    Module Responsible   Prof. Gerhard Bauch   Rectation Section (small)   2   2   2    Module Responsible   Prof. Gerhard Bauch   Rectation Section (small)   2   2    Mathematics 1-3   Recommended   The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover Previous Knowledge by the modulis Mathematik 1-3 is expected. Further experience with spectral transformations (Fourisce Section 1)   Rectational Objectives   After tarking part successfully, students have reached the following learning results   Professional   Competence   Rectational Objectives   After tarking part successfully, students have reached the following learning results   Rectational Objectives   After tarking part successfully, students have reached the following learning results   Rectational Objectives   After tarking part successfully, students have reached the following learning results   Rectational Objectives   Rectational Ob		Tim Hardade CD			
Module Responsible   Prof. Gerhard Bauch		<b>,,</b>			
Recommended The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover Previous Knowledge Previous Knowledge Previous Knowledge in maths as cover the moduls Mathematik: 1-3 is expected. Further experience with spectral transformations (Fourisseries, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence The students are able to classify and describe signals and linear time-invariant (ITI) systems using the students are able to classify and describe and analyse determinist 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 and 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 methods of signal and system theory. They can analyse and design basic systems regarding methods of signal and system theory. They can analyse and design basic systems regarding the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They can also the students are able to acquire relevant information from appropriate literature sources. They can determine the students are able to acquire relevant information from appropriate literature sources. They can demand the describe and analyse and design basic systems reported in the students are able to acquire relevant information from appropriate literature sources. They can demand the describe and analyse deterministic signals and linear time-invariant system theory. The students are able to acquire relevant information from appropriate literature sou	•	,			
Recommends The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover Previous Knowledge Previous Knowledge by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fouries series, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence  The students are able to classify and describe signals and linear time-invariant (ICI) systems using the students are able to classify and describe signals and systems. They can describe and analyse determinist 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 and 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 methods of signal and system theory. They can analyse and design basic systems regarding methods of signal and system theory. They can analyse and design basic systems regarding the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They can also the students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tool cicker system.  Workload in Hours independent Study Time 110, Study Time in Lecture 70  Credit points is  Examination duration  General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German progra	Module Responsible	Prof. Gerhard Bauch			
Recommended Previous Knowledge In mediul is an introduction to the theory of signals and systems. Good knowledge in maths as cover by the moduls Mathematik: 1-3 is expected. Further experience with spectral transformations (Fourischer Special Competence) and the moduls Mathematik: 1-3 is expected. Further experience with spectral transformations (Fourischer Special Competence) and the moduls of signal and system theory. They are able to apply the fundamental transformations (Mathematical Competence) and 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, the discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence!  Social Competence!  Social Competence!  Social Competence!  Social Competence of the students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They can asset the impact of LTI systems on the signal properties in time and frequency domain.  Workload in Hours!  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation formular Science: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German	Admississ				
Recommended Previous Knowledge in maths as cover Previous Knowledge by the modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourisseries, Fourier transform, Laplace transform) is useful but not required.  Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  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 on the 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, the diffects 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 regarding methods of signal and systems theory. They can analyse and design basic systems regarding mortant properties such as magnitude and phase responses, stability, linearity etc They can asset the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software tool citicer system.  Workload in Hours  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineerin	Requirements				
Previous Knowledge by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourises-Fourier transform, Laplace transform) is useful but not required.  Educational Objectives  Professional Competence  The students are able to classify and describe signals and linear time-invariant (ITI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations (Knowledge Signals and system signals and systems. They can describe and analyse deterministic signals and systems and discrete-time signals. In particular, they understand the effects in time domain and image domain with are caused by the transition of a continuous-time and discrete-time signal.  The students are able to describe and analyse deterministic signals and signals and systems mature 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 are able to acquire relevant information from appropriate literature sources. They can account of their level of knowledge during the lecture period by solving tutorial problems, software tool citicker system.  Workload in Hours  Credit points  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Computer Sciences Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Covid-and Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program): 7 semester): Specialisation Process Engineering Compulsory General Engineer		Mathematics 1-3			
Professional Competence  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 signals and systems mathematically in both time and image domain. In particular, they understand the signals and systems mathematically in both time and image domain. In particular, they understand the signals and systems mathematically in both time and image domain. In particular, they understand the signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-invariant system signal to the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Focial Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They ce Autonomy critoriot their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours  Examination Written exam  Examination Written exam  Examination Written exam  Examination duration  and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory		by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Four			
Professional Competence  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 inclinuous-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 the signals and systems mathematically in both time and image domain. In particular, they understand the 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 using methods of signal and system theory. They can analyse and design basic systems regarding the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They ce Autonomy or control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours  Credit points  Examination duration  and scale  General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Electrical Engineering Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 se	Educational Objectives	After taking part successfully, students have reached the following learning results			
The students are able to classify and describe signals and linear time-invariant (ITI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations on 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 it 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 regardin by the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students are able to acquire relevant information from appropriate literature sources. They can asses the impact of LTI systems on the signal properties in time and frequency domain.  The students are able to acquire relevant information from appropriate literature sources. They can discrete the impact of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  The students are able to acquire relevant information from appropriate literature sources. They can describe an advantage of the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  The students are able to acquire relevant information from appropriate literature sources. They can describe an advantage and the lecture period by solving tutorial problems, software tool clicker systems.  Examination Muration  General Engineering Science (German program): Specialisation Electrical Engineering Compulsory General Engineering Science (German program): Specialisation Biopr					
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 signals and systems mathematically in both time and image domain. In particular, they understand it refects in time domain and image domain which are caused by the transition of a continuous-tim 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 assert the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They can according to the feet of knowledge during the lecture period by solving tutorial problems, software tool citicker system.  Workload in Hours  Examination Written exam  Examination duration and scale  General Engineering Science (German program): Specialisation Electrical Engineering: 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 Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Democrates Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisatio					
Skills using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stabilty, linearity etc They can assert the impact of LTI systems on the signal properties in time and frequency domain.  Personal Competence  Social Competence  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tool cicker system.  Workload in Hours  Credit points  Examination Written exam  Examination duration 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 Dioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Dioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Environmental Engeneerin Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering: 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 Mechanical Engineering Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineer	Knowledge	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 determinis signals and systems mathematically in both time and image domain. In particular, they understand t effects in time domain and image domain which are caused by the transition of a continuous-tir signal to a discrete-time signal.			
Social Competence The students can jointly solve specific problems. The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Examination   Written exam    Examination duration   go min    General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Dioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory 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 Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical En	Skills	using methods of signal and system theory. They can analyse and design basic systems regardii important properties such as magnitude and phase response, stability, linearity etc They can asse			
The students are able to acquire relevant information from appropriate literature sources. They control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration 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 Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory 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 Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Science (G	Personal Competence				
Control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and scale 90 min  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 Mechanical 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): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory 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 Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Science	Social Competence				
Credit points   Examination   Written exam	Autonomy				
Examination duration 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 Divide and Environmental Engeneerin 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Bioprocess Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences (Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechatronics: Compulsory	Workload in Hours				
Seamination duration and scale   90 min	Credit points	6			
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 Civil- and Enviromental Engeneerin 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Scienc Compulsory 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 Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechatronics: Compulsory	Examination	Written exam			
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 Civil- and Enviromental Engeneerin 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 Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory 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 Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Alteraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Compulsory		90 min			
Focus Theoretical Mechanical 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 Civil- and Environmental 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, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Biomedical 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 (German program, 7 semester): Specialisation Mechanical Engineering Focus 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 Science (German program, 7 semester): 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 Mechanical Engine			

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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals	and Systems				
Тур	Lecture				
Hrs/wk					
СР					
	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 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 (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	rof. Gerhard Bauch		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0680: F	luid Dynamics				
Courses					
Title Fluid Mechanics (L0454) Fluid Mechanics (L0455)	<b>Typ</b> Lecture Recitati	e ion Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2	
Module Responsible		, , ,			
Admission Requirements	-				
•	Sound knowledge of engineering mathematics, engineerin	g mechanics and t	thermodynar	nics.	
Educational Objectives	After taking part successfully, students have reached the f	following learning	results		
Professional Competence					
Knowledge	Students will have the required sound knowledge to expland physics of fluids. Students can scientifically ou mathematical models and are familiar with methods for the fluid engineering devices.	tline the rationa	le of flow	physics using	
Skills	Students are able to apply fluid-engineering principles technical systems. The lecture enables the student to ca for the fluid dynamic design of engineering devices on a so	rry out all necess	models for a	the analysis o cal calculations	
Personal Competence	The students are able to discuss problems and jointly deve	elop solution strate	egies.		
Social Competence					
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Examination	Written exam				
Examination duration and scale	1 1 8 U 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 (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 Naval Architecture Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				

Course L0454: Fluid Mechanics			
Тур	cture		
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			
СР				
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Lecturer	rof. Thomas Rung			
Language	DE			
Cycle	SoSe			
Content	See interlocking course			
Literature	ee interlocking course			

Module M0960: Multibody Systen	Mechanics IV (Kinetics II, ( ns)	Oscillations,	Analytical	Mechanics	
Courses					
(L1137) Mechanics IV (Kinetics II, Os (L1138) Mechanics IV (Kinetics II, Os	scillations, Analytical Mechanics, Multibody Systems) scillations, Analytical Mechanics, Multibody Systems) scillations, Analytical Mechanics, Multibody Systems)	Typ Lecture Recitation Section ( Recitation Section (		<b>CP</b> 3 2	
(L1139)		Recitation Section (	iarge, 1	-	
Module Responsible  Admission Requirements					
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III				
	After taking part successfully, students have rea	ched the following lea	arning results		
Professional Competence					
Knowledge	<ul> <li>describe the axiomatic procedure used in</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>	mechanical contexts	;		
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 wider problem sets.</li> </ul>				
Personal Competence Social Competence	The students can work in groups and support each			ganize their tim	
	and learning based on those.				
	Independent Study Time 96, Study Time in Lectu	re 84			
Credit points	Written exam				
Examination duration					
and scale	1 1 2 U min				
Assignment for the Following Curricula	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): General Engineering Science (English program): Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsor Technomathematics: Specialisation III. Engineeri Theoretical Mechanical Engineering: Technical	Specialisation Biome Specialisation Naval , 7 semester): Speci , 7 semester): Speci , 7 semester): S Specialisation Mecha Specialisation Biome Specialisation Naval , 7 semester): Speci , 7 semester): Speci m, 7 semester): S	edical Engineering Architecture: Colialisation Mechar ialisation Biomedical Engineering dical Engineering Architecture: Cortialisation Mechar ialisation Biomedical Engineering Architecture: Cortialisation Mechar ialisation Biomedical Engineering Architecture: Cortialisation Mechar ialisation Biomedicalisation Na	g: Compulsory mpulsory ical Engineering lical Engineering val Architecture g: Compulsory : Compulsory inpulsory ical Engineering	

Course L1137: Mechani	ics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
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	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> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</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: Mechani	Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent 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: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)			
Тур	Typ 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		

Module M1277: M	IED I: Introduction to Anato	omy		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Anatomy (L0	384)	Lecture	2	3
Module Responsible	Prof. Udo Schumacher			
Admission Requirements				
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lea	arning results	
Professional Competence <i>Knowledge</i>	The students can describe basal struct system.		•	musculoskeleta
	The students can describe the basic macroscopy and microscopy of those systems.  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	The students can participate in curr	rent discussions in biomedic	al research and	medicine on a
Social Competence	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.			
<b>Workload in Hours</b>	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focu 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, Focu 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 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			

Course L0384: Introduc	tion to Anatomy		
Тур	Lecture		
Hrs/wk			
СР	3		
Workload in Hours	Independent Study	Time 62, Study Time in Lecture 28	
Lecturer	Prof. Tobias Lange		
Language			
Cycle			
	General Anatomy  1 <sup>st</sup> week:  2 <sup>nd</sup> week:	The Eucaryote Cell The Tissues	
	3 <sup>rd</sup> week: 4 <sup>th</sup> week:	Cell Cycle, Basics in Development  Musculoskeletal System	
	5 <sup>th</sup> week: 6 <sup>th</sup> week:	Cardiovascular System Respiratory System	
Content	7 <sup>th</sup> week: 8 <sup>th</sup> week:	Genito-urinary System  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/Michae	l Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012	

Courses				
<b>Fitle</b> ntroduction to Radiology ar	nd Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	None			
ducational Objectives	After taking part successfully, students ha	ave reached the following	learning results	
Professional Competence				
	<b>Therapy</b> The students can distinguish different tradiation therapy.	ypes of currently used ec	quipment with respe	ct to its use
	The students can explain treatment plar surgery, internal medicine).	s used in radiation therap	oy in interdisciplinar	y contexts (e.
	The students can describe the pation follow-up care.	ents' passage from the	ir initial admittan	ce through
	Diagnostics			
Knowledge	The students can illustrate the tech angiography and mammography, as well			
	The students can explain the diagnostic a technical basis for those techniques.	s well as therapeutic use o	of imaging technique	s, as well as t
	The students can choose the right treat needs.	ment method depending	on the patient's clin	ical history a
	The student can explain the influence of t	echnical errors on the ima	iging techniques.	
	The student can draw the right conclus protocol.	sions based on the image	es' diagnostic findin	gs or the err
	<b>Therapy</b> The students can distinguish curative al conclusion.	nd palliative situations an	d motivate why the	y came to th
	The students can develop adequate thera	py concepts and relate it t	to the radiation biolo	gical aspects.
	The students can use the therapeutic prir	nciple (effects vs adverse e	effects)	
	The students can distinguish different ki situation (location of the tumor) and choo			
Skills	The student can assess what an indiv treatment, sports, social help groups, self			
	Diagnostics			
	The students can suggest solutions for analyses.	repairs of imaging instru	ımentation after hav	ving done err
	The students can classify results of imagi on their knowledge of anatomy, patholog		o different groups of	diseases base
Personal Competence				
	The students can assess the special so	cial situation of tumor pa	atients and interact	with them in
Social Competence	professional way. The students are aware of the special diagnostic and therapeutic measures and	, often fear-dominated b can meet them appropria	ehavior of sick pec tely.	pple caused l
	The students can apply their new knowled The students can introduce younger stud			
Autonomy	The students are able to access anatomi conversations on the topic and acquire th			competently
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28		
	· · · · · · · · · · · · · · · · · · ·	<u> </u>		
Credit points	3			

## **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: 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 Assignment for the General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory 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

ırse L0383: Introduc	tion to Radiology and Radiation Therapy
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Language	Prof. Ulrich Carl, Prof. Thomas Vestring  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. It 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</li> <li>ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer - 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg - erschiener 08.12.2009</li> <li>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</li> <li>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</li> <li>ISBN: 978-3-13-329716-5</li> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer - 1. Auflage - Springer-Verlag GmbH - erschienen 02.06.2000</li> </ul>

Module M0598: M	lechanical Engineering: Design			
Courses				
<b>Title</b> Embodiment Design and 3D	0-CAD (L0268)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
Mechanical Design Project I	(L0695)	Project-/problem-based Learning	3	2
Mechanical Design Project I	I (L0592)	Project-/problem-based Learning	3	2
Team Project Design Metho	dology (L0267)	Project-/problem-based Learning	2	1
Module Responsible				
Admission Requirements	INONE			
Recommended Previous Knowledge		g Design		
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learni	ng results	
Professional Competence				
Knowledge	After passing the module, students are able to:  • explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,  • describe basics of 3D CAD,  • explain basics methods of engineering designing.			
Skills	After passing the module, students are able to:  • independently create sketches, technical drawings and documentations e.g. using 3D CAD,  • design components based on design guidelines autonomously,  • dimension (calculate) used components,  • use methods to design and solve engineering design tasks systamtically and solution-oriented,  • apply creativity techniques in teams.			
Personal Competence				
Social Competence	After passing the module, students are able to:  develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course.			
Autonomy	Students are able  • to estimate their level of knowledge using activating methods within the lectures (e.g. with			
Workload in Hours	Independent Study Time 40, Study Time in Lec	ture 140		
Credit points				
Examination duration	Written exam 180			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory 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, 7 semester): Specialisation Mechanical Engineering:			

Course L0268: Embodiment 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: Mechanical Design Project I	
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	
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</li> <li>(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	Project-/problem-based Learning	
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	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.	

Course L0267: Team Pr	oject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	Introduction to engineering designing methodology  Team Project Design Methodology  Creating requirement lists  Problem formulation  Creating functional structures  Finding solutions  Evaluation of the found concepts  Documentation of the taken methodological steps and the concepts using presentation slides
Literature	<ul> <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		
Title	Typ         Hrs/wk         CP           0417)         Lecture         2         3	
Numerical Mathematics I (L. Numerical Mathematics I (L.	,	
Module Responsible	Prof. Sabine Le Borne	
Admission		
Requirements		
Recommended Previous Knowledge	I tor Lachnomathematicians	
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results	
Professional Competence		
Competence	Students are able to	
Knowledge	<ul> <li>name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas,</li> </ul>	
	Students are able to	
Skills	<ul> <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		
	Students are able to	
Social Competence	<ul> <li>work together in heterogeneously composed teams (i.e., teams from different study progran and background knowledge), explain theoretical foundations and support each other wi practical aspects regarding the implementation of algorithms.</li> </ul>	
	Students are capable	
Autonomy	<ul> <li>to assess whether the supporting theoretical and practical excercises are better solve 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 Lecture 56	
Credit points	6	
	Written exam	
Examination duration and scale		
and scale	General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Theoretical Mechanical Engineering: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory	
Following Curricula		

Focus Biomechanics: 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 Theoretical Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: 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	
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 für Ingenieure und Naturwissenschaftler, Springer</li> </ul>	

Course L0418: Numeric	Course L0418: Numerical Mathematics I	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne, Dr. Jens-Peter Zemke	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0684: H	eat Transfer			
Courses				
<b>Title</b> Heat Transfer (L0458) Heat Transfer (L0459)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	None			
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics	5		
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
	The students are able to			
	- describe the different physical mechanism of Hea	t Transfer,		
Knowledge	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a cri	itical way.		
	The students are able to			
	- understand the physics of Heat Transfer,			
Skills	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small grou	ps.		
Personal Competence				
Social Competence	The students are able to discuss in small groups ar	nd develop an approach.		
Autonomy	The students are able to develop a complex proble way. A qualified exchange with other students is gi		alyse the resu	ılts in a critical
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 Focus Energy Systems: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Focus Theoretical Mechanical Engineering: Elective Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 Focus Energy Systems: Compulsory General Engineering Science (English program, 7 Compulsory General Engineering Science (English program, 7 Focus Theoretical Mechanical Engineering: Elective Mechanical Engineering: Specialisation Energy Systems Specialisation Theoretical	7 semester): Specialisation 7 semester): Specialisation 7 compulsory 8 Core Studies: Elective Corty 9 semester): Specialisation 7 semester): Specialisation 9 semester): Specialisation 9 compulsory 9 tems: Compulsory	on Biomedica on Mechanica ompulsory on Mechanica on Biomedica	Il Engineering: Il Engineering, Il Engineering, Il Engineering: Il Engineering:

Course L0458: Heat Tra	ansfer	
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	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 - Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996	

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				
Measurement Technology fo	ent 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	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ectrical engineering		
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence	Students are able to name the most importan			
Knowledge	and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems).  They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).  They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Garchromatography)			
Skills	Students can select suitable measuring methodevices in practice.  The students are able to orally explain issus solution approaches as well as place the issue	es in the subject area of me	asurement	technology an
Personal Competence  Social Competence	Students can arrive at work results in groups	and document them in a comm	non report.	
Autonomy	Students are able to familiarize themselves w	th new measurement technolo	ogies.	
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Examination				
Examination duration and scale	105 minutes			
Assignment for the	General Engineering Science (German progratengineering: Compulsory General Engineering Science (German progratengineering Engineering Science (German progratengineering Engineering Science (German progratengineering Engineering Engineering: Core General Engineering Science (English progratengineering: Compulsory General Engineering Science (English progratengineering Engineering Engineering Engineering Engineering Engineering Engineering Engineering: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory	am, 7 semester): Specialisation, 7 semester):	on Mechanion Biomedion Biomedion Energy aron Mechanion	cal Engineering cal Engineering nd Enviroment cal Engineering

ourse L1119: Practica	l Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	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
Literature	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufi., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmiger 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> <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> <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>

Course L1116: Measurement Technology for Mechanical and Process Engineers		
	Lecture	
Hrs/wk		
СР		
	Independent Study Time 62, Study Time in Lecture 28	
Language	Prof. Roland Harig	
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	
301113111	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 of the class.	
_	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.	
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.	

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

Module M1279: M	1ED II: Introduction to Biochemistry and Molecular Biology
Courses	
Title Introduction to Biochemistry	y and Molecular Biology (L0386) Typ Hrs/wk CP Lecture 2 3
Module Responsible	Prof. Hans-Jürgen Kreienkamp
Admission Requirements	
Recommended Previous Knowledge	None
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
Professional Competence	The students can
Knowledge	<ul> <li>describe basic biomolecules;</li> <li>explain how genetic information is coded in the DNA;</li> <li>explain the connection between DNA and proteins;</li> </ul>
Skills	The students can  • recognize the importance of molecular parameters for the course of a disease;  • describe selected molecular-diagnostic procedures;  • explain the relevance of these procedures for some diseases
Personal Competence	
Social Competence	The students can participate in discussions in research and medicine on a technical level.
	The students can develop understanding of topics from the course, using technical literature, b themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	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, 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 Management and Business Administration: 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 Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course 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	DE	
Cycle	WiSe	
Content		
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage	
	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008	
Literature		

Courses				
Courses				
<b>Title</b> Introduction to Control Syst	ems (10654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Requirements	Representation of signals and systems in	time and frequency domain. Lanla	co transform	`
Recommended Previous Knowledge		time and frequency domain, Lapla	ce transioni	ı
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 in term 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 frequence response</li> <li>They can explain issues arising when controllers designed in continuous time domain an 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 and frequer response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks</li> </ul>		rules s and frequenc nuous-time an	
Personal Competence  Social Competence	Students can work in small groups to join	tly solve technical problems, and e	xperimental	ly validate the
σοσ	controller designs Students can obtain information from experiment guides) and use it when solvi		, software	documentatio
Autonomy	They can assess their knowledge in week	ly on-line tests and thereby control	their learni	ng progress.
Workload in House	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	· · · · · · · · · · · · · · · · · · ·	, in Ecclure 30		
·	Written exam			
Examination duration				
and scale	General Engineering Science (German	program, 7 semester). Special	isation Com	nputer Science
	Compulsory			
	General Engineering Science (German p Compulsory	program, 7 semester): Specialisati	on Bioproce	ss Engineerin
	General Engineering Science (German	program, 7 semester): Speciali	sation Nava	al Architectur
	Compulsory General Engineering Science (German	n program, 7 semester): Specia	lisation Civ	ril Engineerin
	Compulsory			
	General Engineering Science (German Compulsory	program, / semester): Specialisa	tion Electric	al Engineerin
	General Engineering Science (German p	program, 7 semester): Specialisati	on Biomedic	cal Engineerin
	Compulsory General Engineering Science (German p	rogram, 7 semester): Specialisatio	n Energy ar	nd Enviroment
	Engineering: Compulsory General Engineering Science (German			
	Compulsory			
	General Engineering Science (German p	orogram, / semester): Specialisation	on Mechanic	cal 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, 7 semester): Specialisation Computer Science:

**Assignment for the** Compulsory

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

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

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: Introduc	tion to Control Systems
Tvp	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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M1333: B	IO I: Implants and Fracture	Healing		
Courses				
<b>Title</b> Implants and Fracture Heali	ng (L0376)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "I Fracture Healing".	ntroduction into Anatomie"	before attending	"Implants and
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following lea	arning results	
Professional Competence				
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence. The students can name different treatments for the spine and hollow bones under given fracture morphologies.			
Skills	The students can determine the forces under specific assumptions.	acting within the human b	oody under quasi-s	tatic situations
Personal Competence				
Social Competence	The students can, in groups, solve basic r	numerical modeling tasks for	the calculation of i	nternal forces.
Autonomy	The students can, in groups, solve basic r	numerical modeling tasks for	the calculation of i	nternal forces.
Workload in Hours	Independent Study Time 62, Study Time	n Lecture 28		
Credit points	3			
Examination				
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German procus Biomechanics: Compulsory General Engineering Science (German procus Biomechanics: Compulsory General Engineering Science (English procus Biomechanics: Compulsory General Engineering Science (English procus Biomechanics) Specialisation Bi Biomedical Engineering: Specialisation Bi Biomedical Engineering: Specialisation Imbiomedical Engineering: Specialisation Imbiomedical Engineering: Specialisation Micromedical Engineering: Specialisation Mic	rogram, 7 semester): Speci rogram, 7 semester): Speci rogram, 7 semester): Speci omechanics: Compulsory Artificial Organs and F aplants and Endoprostheses: edical Technology and Contranagement and Business Ad	ialisation Biomedicalisation Mechanicalisation Biomedicalisation Biomedicalisation Med  Regenerative Med  Elective Compulsool Theory: Elective	al Engineering: al Engineering, al Engineering: icine: Elective ry Compulsory
	Technomathematics: Specialisation III. Er		Compulsory	

Course L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Language	Prof. Michael Morlock
Cycle	
	Topics to be covered include:
	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. L. Orthon ädische Biomechanik
	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	Nigg, B.: Biomechanics of the musculo-skeletal system Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

Module M0829: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives Professional	After taking part successfully, students have reach	ed the following learning	results	
Competence				
Knowledge	After taking this module, students know the impo Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Econom Management and to name important definit: • explain the most important aspects of and aspects of entreprneurial projects • describe and explain basic business function chain management, organization and huma innovation management and marketing • explain the relevance of planning and demultiple objectives and uncertainty, and Finance • state basics from accounting and costing and material management.	Marketing and Innovation, nics and Management at ions from the field of Management and unsured as production, procure n ressource management cision making in Busines explain some basic me	and also to land the sulagement domain name the ement and so, informations, esp. in sethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
Skills	Students are able to analyse business units with a strategies etc.) and to carry out an Entrepreneursh  analyse Management goals and structure th analyse organisational and staff structures of apply methods for decision making under methods analyse production and procurement systemes analyse and apply basic methods of marketies select and apply basic methods from mathees apply basic methods from mathe	nip project in a team. In pa em appropriately of companies ultiple objectives, under uns and Business informations ing matical finance to predefin	incertainty a on systems	y are able to  nd under risk
Personal Competence	Students are able to			
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture is		roject and w	rite a coherent
	Students are able to			
Autonomy		emselves		
Workland in Harres	Independent Study Time 110 Study Time in Lastry	ro 70		
Credit points	Independent Study Time 110, Study Time in Lectur	C 10		
•	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

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

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

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 Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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Assignment for the Following Curricula

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. Kathrin 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Courses				
		<b>-</b>	Hara farala	CD.
Title Introduction into Medical Technology and Systems (L0342) Introduction into Medical Technology and Systems (L0343) Introduction into Medical Technology 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	None			
Recommended Previous Knowledge	principles of math (algebra, analysis/cald principles of stochastics principles of programming, R/Matlab	culus)		
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	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 syster	ns and medical devices in the conte	xt of clinical	applications.
<b>Personal Competence</b>				
Social Competence	The students describe a problem in med a joint effort.	ical technology as a project, and de	fine tasks th	nat are solved
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 Tim	e in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	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, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective 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 Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Course L0342: Introduction 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.	

Course L0343: Introduc	ourse L0343: Introduction into Medical Technology and Systems		
Тур	Project Seminar		
Hrs/wk	2		
СР	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	
СР	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: M	1ED II: Introduction to Phys	iology		
Courses				
Title Introduction to Physiology (	L0385)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lear	ning results	
Professional Competence				
	The students can			
Knowledge	<ul> <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 effects of information, development of forces and			
Personal Competence				
Social Competence	The students can conduct discussions in The students can find solutions to proble			d 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 Time	e in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	INU MINUTES			
Assignment for the Following Curricula	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, 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			

Course L0385: Introduction to Physiology		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Gerhard Engler, 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: B	IO I: Experimental Methods i	n Biomechanics			
Courses					
<b>Title</b> Experimental Methods in Bio	omechanics (L0377)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	INONE				
		antate und Frakturheilung"	before attending '	Experimentelle	
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following lea	rning results		
Professional Competence					
Knowledge	The students can describe the different ways how bones heal, and the requirements for their The students can name different treatments for the spine and hollow bones under give morphologies.				
	The students can describe different measurement techniques for forces and movements, and choos the adequate technique for a given task.				
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.			iques used in	
Personal Competence					
Social Competence	<u> </u>				
Autonomy	The students can, in groups, solve basic ex	rperimental tasks.			
Workload in Hours	Independent Study Time 62, Study Time in	Lecture 28			
Credit points	3				
	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Science (German pr Focus Biomechanics: Compulsory General Engineering Science (German pr Compulsory General Engineering Science (English pro Focus Biomechanics: Compulsory General Engineering Science (English pro Compulsory Mechanical Engineering: Specialisation Bio Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Ma Technomathematics: Specialisation III.	ogram, 7 semester): Special ogram, 7 semester): Special ogram, 7 semester): Special mechanics: Compulsory Artificial Organs and R olants and Endoprostheses: dical Technology and Control	alisation Biomedicalisation Mechanicalisation Biomedicalisation Biomedicalisation Biomedicalisation Medicalisation Medicalisation Biomedicalisation Biomedic	al Engineering: al Engineering; al Engineering: icine: Elective ry Compulsory	

Course 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.

Module M0833: I	ntroduction to Control S	Systems			
Courses					
Title Introduction to Control Syst Introduction to Control Syst		<b>Typ</b> Lecture Recitation	Section (small)	Hrs/wk 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			ı	
Educational Objectives	After taking part successfully, stu	dents have reached the follo	owing learning	results	
Professional Competence					
Knowledge	They can explain the dynar of frequency response and     They can explain the Myguin	s of first and second order s nics of simple control loops root locus st stability criterion and the f the phase margin in analy a a PID controller affects	systems and interpret of stability margi sis and synthes a control loop	dynamic prop ns derived f sis of control in terms o	perties in term rom it. loops f its frequenc
Skills	Students can transform movice versa They can simulate and assorted they can design PID contrology. They can analyze and synt response techniques They can calculate discrete use it for digital implement They can use standard soft tasks	ess the behavior of systems llers with the help of heuris hesize simple control loops e-time approximations of co ation	and control loc tic (Ziegler-Nich with the help o ontrollers desig	ops nols) tuning of root locus ned in conti	rules and frequend nuous-time ar
Personal Competence					
Social Competence	Students can work in small group	s to jointly solve technical p	roblems, and e	xperimental	ly validate the
	Students can obtain information experiment guides) and use it wh		(lecture notes	, software	documentatio
Autonomy	They can assess their knowledge	in weekly on-line tests and t	thereby control	their learnir	ng progress.
	Independent Study Time 124, Stu	dy fime in Lecture 56			
Credit points	<u> </u>				
Examination duration and scale	Written exam 120 min				
	General Engineering Science (Ger General Engineering Science (Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory	German program, 7 seme rman program, 7 semeste German program, 7 seme	ester): Specialisations: ester): Specialisations ester): Speciali	sation Com on Bioproce: sation Nava	ss Engineering
		[542]			

Compulsory

Assignment for the

**Following Curricula** 

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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: 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 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

Compu

Course L0654: Introduc	tion 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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ, 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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	

Module M0730: C	Computer Engineering			
Courses				
Title Computer Engineering (L03 Computer Engineering (L03		on 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				nation's mark
Educational Objectives	J	ollowing learning r	esults	
Professional		onowing rearring r	CSUICS	
Competence				
Knowledge	<ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthe 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, pipelini</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-poconnections, busses</li> </ul>			ure, pipelining
Skills	The students perceive computer systems from the arc internal structure and the physical composition of computingly specific and individual computers can be built components. They are able to distinguish between and today's computing systems - from gates and circuits up to After successful completion of the module, the student between a physical computer system and the softwar understand the consequences that the execution of softwork layers from the assembly language down to gates. This impact that these low abstraction levels have on an efeasible options.	ter systems. The based on a collect of explain the difficult of the complete processor are able to judge executed on its vare has on the has way, they will be	students callection of fe erent abstracts. Ige the inte In particulardware-cent e enabled to	n analyze, how we and simple ction layers of ordependencies lar, they shal tric abstraction of evaluate the
Personal Competence				
	Students are able to solve similar problems alone or in a g	roup and to preser	nt the results	accordingly.
Autonomy	Students are able to acquire new knowledge from specif with other classes.	ic literature and to	associate t	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	-		
Credit points				
Examination duration	190 minutes contents of course and lans			
and scale				
	General Engineering Science (German program): Core qua General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 sem Compulsory General Engineering Science (German program, 7 sem Compulsory	emester): Specialis ster): Specialisation mester): Specialis emester): Specialis ester): Specialisat	sation Com on Bioproces sation Nava isation Civi ion Electrica	s Engineering I Architecture I Engineering al Engineering

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 Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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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	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	•			
<b>Fitle</b> Management Tutorial (L088)	<b>Typ</b> 2) Recitation Section	Hrs/ n (large) 2	WK	<b>CP</b> 3
ntroduction to Management		3		3
Module Responsible	Prof. Christoph Ihl			
Admission	None			
Requirements Recommended				
Previous Knowledge	Basic Knowledge of Mathematics and Business			
ducational Objectives Professional	After taking part successfully, students have reached the following l	earning result	5	
Competence				
Knowledge	<ul> <li>After taking this module, students know the important basics of m Management, from Planning and Organisation to Marketing and Inn Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and to name important definitions from the field explain the most important aspects of and goals in Manager aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production chain management, organization and human ressource manainnovation management and marketing</li> <li>explain the relevance of planning and decision making in multiple objectives and uncertainty, and explain some befinance</li> <li>state basics from accounting and costing and selected control</li> </ul>	ement and the dof Management and nament and nament agement, informations, especially agements, especially methods	ne subent ent e the and sometion on in significant	nvestment a p-disciplines most importa ourcing, supp n manageme ituations und
	Students are able to analyse business units with respect to differe strategies etc.) and to carry out an Entrepreneurship project in a tea.  • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives • analyse production and procurement systems and Business in • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to apply basic methods from accounting, costing and controlling	am. In particula , under uncerta nformation sys o predefined pi	ainty a tems	y are able to nd under risk s
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 entreprene report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>	urship project	and w	rite a cohere
	Students are able to			
Autonomy	<ul><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 Lecture 70			
Credit points	6			
•	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program): Specialisation Electoric Engineering Science (German program): Specialisation Common Engineering Science (German program): Specialisation Programs: Specialisation Programs: Specialisation Biograms: Specialisation Biograms: Specialisation Engineering Science (German program): Specialisation Engineering Engineering Science (German program): Specialisation Cicompulsory General Engineering Science (German program): Specialisation MecGeneral Engineering Science (German program): Specialisation Biograms: Specialisation Science (German program): Specialisation Nav General Engineering Science (German program): Specialisation Nav General Engineering Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program): Specialisat	nputer Science tess Engineering process Engine ergy and Envirously vil- and Envirously hanical Engine medical Engine al Architecture	: Compage: Compage: Coment com	oulsory mpulsory Compulsory al Engineerir Engeneerir Compulsory Compulsory oulsory

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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
                    General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering:
Assignment for the
                    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 Enviromental Engineering:
                     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
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Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	tion to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. Kathrin 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M0854: N	Mathematics IV			
Courses				
Differential Equations 2 (Pa		Typ Lecture Recitation Section (small, Recitation Section (large) Lecture Recitation Section (small, Recitation Section (large)	1 2 1	CP 1 1 1 1 1 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge				
	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concept appropriate examples.</li> <li>Students can discuss logical connections with the illustrating these connections with the They know proof strategies and can remark.</li> </ul>	ections between these conce e help of examples.	·	ain them using are capable of
Skills	<ul> <li>Students can model problems in Ma course. Moreover, they are capable o</li> <li>Students are able to discover and studied in the course.</li> <li>For a given problem, the students cal critically evaluate the results.</li> </ul>	of solving them by applying esta verify further logical connec	ablished meth cions betwee	nods. n the concepts
Personal Competence  Social Competence	<ul> <li>Students are able to work together in language.</li> <li>In doing so, they can communicate partners. Moreover, they can design peers.</li> </ul>	new concepts according to th	e needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking the can specify open questions precisely</li> <li>Students have developed sufficient problems oriented manner on hard problems.</li> </ul>	and know where to get help in	solving them.	,
Workload in Hours	Independent Study Time 68, Study Time in I	Lecture 112		
Credit points	· · · · · · · · · · · · · · · · · · ·			
	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	erential Equations 2)		
	General Engineering Science (German programmeral Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German programmeral Engineering Science (German pr	program): Specialisation Meconogram): Specialisation Meconogram): Specialisation Meconogram): Specialisation Naval Archogram, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation	hanical Engi hanical Engi itecture: Com ation Electric tion Mechanic	neering, Focus neering, Focus pulsory cal Engineering: cal Engineering, cal Engineering,

	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					
Assignment for the	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 L1043: Differen	tial Equations 2 (Partial Differential Equations)
Тур	Lecture
Hrs/wk	2
СР	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	Main features of the theory and numerical treatment of partial differential equations  Examples of partial differential equations First order quasilinear differential equations  Normal forms of second order differential equations  Harmonic functions and maximum principle  Maximum principle for the heat equation  Wave equation  Liouville's formula  Special functions  Difference methods  Finite elements
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

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: Differen	ourse 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	ecture			
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	oSe			
Content	Main features of complex analysis  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation			
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html			

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			

Course 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 M0960: Multibody Systen	Mechanics IV (Kinetics II, ( ns)	Oscillations,	Analytical	Mechanics	
Courses					
(L1137) Mechanics IV (Kinetics II, Os (L1138) Mechanics IV (Kinetics II, Os	cillations, Analytical Mechanics, Multibody Systems) cillations, Analytical Mechanics, Multibody Systems) cillations, Analytical Mechanics, Multibody Systems)	Typ Lecture Recitation Section ( Recitation Section (		<b>CP</b> 3 2	
(L1139)		Recitation Section (	iarge, 1	-	
Module Responsible Admission Requirements					
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III				
	l	ched the following le	arning results		
Professional Competence			-		
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>				
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 wider problem sets.</li> </ul>				
Personal Competence Social Competence	The students can work in groups and support eac Students are capable of determining their own			ganize their tim	
Autonomy	and learning based on those.				
	Independent Study Time 96, Study Time in Lectu	re 84			
Credit points	Written exam				
Examination duration					
and scale	1 1 2 0 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 (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory				

Course L1137: Mechani	cs IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)				
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	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> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</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: 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					
Title		ур	Hrs/wk	СР	
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		ecture ecitation Section (large)	3 2	4 2	
Module Responsible	Prof. Thomas Rung				
Admission					
Requirements					
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engin	eering mechanics and t	hermodyna	mics.	
	After taking part successfully, students have reached	I the following learning r	esults		
Professional					
Competence	Students will have the required sound knowledge to	explain the general price	nciples of fl	uid engineerin	
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using 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 calculations for the fluid dynamic design of engineering devices on a scientific level.				
Personal Competence					
	The students are able to discuss problems and jointly develop solution strategies.				
Social Competence					
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.				
	Independent Study Time 110, Study Time in Lecture	70			
Credit points					
Examination					
Examination duration and scale	180 min				
9	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 (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 Biomedical Engineering 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 Technomathematics: Specialisation III. Engineering Sciences: Elective Compulsory				

Course L0454: Fluid Mechanics		
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>	

ourse 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: S	tochastics and Ship Dynamics			
Courses				
Title Ship Dynamics (L0352) Ship Dynamics (L1620) Statistics and Stochastic Pro (L0364)	ocesses in Naval Architecure and Ocean Engineering	Typ Lecture Recitation Section (small) Lecture	Hrs/wk 2 1	<b>CP</b> 3 1 3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Linear algebra analysis complex numbers</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning i	results	
Professional Competence				
Knowledge	and they can describe the procedure of the manoe  - The students are able to give an overview over rudder design.  - The students can name computation methods waves.	varius rudder types. The	•	
Skills	<ul> <li>The students can come up with the equations of can use and linearise them.</li> <li>The students are able to determine hydrodyna meaning.</li> <li>The students can explain how a rudder works a occur.</li> <li>The students can mathematically describe waves.</li> <li>The students can explain the mathematically describe them.</li> </ul>	mic coefficients and they and they can explain the	can explair	their physical
Personal Competence				
Social Competence	- The students can arrive at work results in groups			
Autonomy	- The students can assess their own strengthes a this basis.	nd weaknesses and the d	efine further	work steps on
Workload in Hours	Independent Study Time 140, Study Time in Lectu	re 70		
Credit points	7			
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German progran Compulsory General Engineering Science (English program Compulsory Naval Architecture: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Cor	, 7 semester): Specialis	sation Nava	l Architecture:

rse L0352: Ship Dy	
	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	<ul> <li>Equations of motion</li> <li>Hydrodynamic forces and moments</li> <li>Linear equations and their solutions</li> <li>Full-scale trials for evaluating the maneuvering performance</li> <li>Regulations for maneuverability</li> <li>Rudder</li> </ul> Seakeeping <ul> <li>Representation of harmonic processes</li> <li>Motions of a rigid ship in regular waves</li> <li>Flow forces on ship cross sections</li> <li>Strip method</li> <li>Consequences induced by ship motion in regular waves</li> <li>Behavior of ships in a stationary sea state</li> <li>Long-term distribution of seaway influences</li> </ul>
Literature	<ul> <li>Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship 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. Berlin Heidelberg, Deutschland, 1992</li> <li>Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, 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 Kingdom, 2001</li> <li>Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989</li> <li>Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004</li> <li>Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998</li> </ul>

Course L1620: Ship Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	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

Tvp	Lecture
Hrs/wk	
СР	
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, Arbeitsbere Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001</li> <li>H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, Journal Wiley &amp; Sons, Inc., New York, NY, 2009</li> <li>ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Ta 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>

Module M0655: C	omputational Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynam Computational Fluid Dynam	•	Lecture Recitation Section (large)	2	3 3
Module Responsible	į	recitation section (large)		
Admission				
Requirements	None			
Recommended Previous Knowledge	Mathematical Methods for Engineers     Fundamentals of Differential/integral c	alculus and series expansions		
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Competence	I The students are able to list the basic numeri	cs of partial differential equation	ons.	
Knowledge				
	The students are able develop appropriate r partial differential equations. They can code of			
Skills		ompatational algorithms in a s		.,.
Skills				
Personal Competence				
Casial Campatana	The students can arrive at work results in gro	ups and document them.		
Social Competence				
	i The students can independently analyse appi	roaches to solving specific prob	lems.	
Autonomy				
	Independent Study Time 124, Study Time in I	Lecture 56		
Credit points				
Examination Examination duration				
and scale	2h 			
	General Engineering Science (German pro	ogram, 7 semester): Speciali	sation Nava	Architecture:
	Compulsory General Engineering Science (German progi	ram, 7 semester): Specialisatio	on Mechanic	al Engineering,
	Focus Energy Systems: Elective Compulsory Energy Systems: Technical Complementary C			
	General Engineering Science (English pro			l Architecture:
Following Curricula	Compulsory General Engineering Science (English progr	am 7 semester). Snecialisatio	n Mechanic	al Engineering
	Focus Energy Systems: Elective Compulsory	•		ar Engineering,
	Mechanical Engineering: Specialisation Energ Naval Architecture: Core qualification: Compu		у	
	Technomathematics: Specialisation III. Engine		lsory	

Course L0235: Computational 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	Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.  1. Partial differential equations 2. Foundations of finite numerical approximations 3. Computation of potential flows 4. Introduction of finite-differences 5. Approximation of convective, diffusive and transient transport processes 6. Formulation of boundary conditions and initial conditions 7. Assembly and solution of algebraic equation systems 8. Facets of weighted -residual approaches 9. Finite volume methods 10. Basics of grid generation	
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer	

Course L0419: Computa	ourse L0419: Computational 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	

Module M0659: F	undamentals of Ship Structural De	esign and Analysi	S	
Courses				
Title Fundamentals of Ship Struc Fundamentals of Ship Struc Fundamentals of Ship Struc Fundamentals of Ship Struc Fundamentals of Ship Struc	tural Design (L0413) tural Analysis (L0410)	Typ Lecture Recitation Section (small) Lecture Recitation Section (small)	Hrs/wk 2 1 2 1	CP 2 2 2 2
Module Responsible	Prof. Sören Fhlers			
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 reach	ned the following learning	results	
Professional Competence				
	Students can reproduce the basic contents of the explain the theory and methods for the calcustructures.	ulation of deformations a	and stresse	s in beam-lik
Knowledge Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished joining and principles of structural design of components in the ship structure.				
Skills	Students are capable of applying the methods and tools for the calculation of linear deformations and stresses in the above mentioned structures; they can choose calculation models of typical ship structures.  Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they car select suitable materials, semi-finished products and joints.			
Personal Competence	!			
Social Competence	The students are able to communicate and coope and component supply industry.	rate in a professional envi	ronment in t	the shipbuildir
Autonomy	The students are capable to independently idealiz for analysis of beam-like structures; they are capa Furthermore, they are capable to assess drawir structures for various requirements and boundary	ble to assess the results ongs of complex ship stru	f structural a	analyses.
Workload in Hours	Independent Study Time 156, Study Time in Lectu	re 84		
Credit points	8			<u> </u>
	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula	General Engineering Science (German progran Compulsory General Engineering Science (English program Compulsory Naval Architecture: Core qualification: Compulsory	n, 7 semester): Speciali		

ourse L0411: Fundamentals of Ship Structural Design	
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	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	1	
СР	2	
<b>Workload in Hours</b>	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: Fundamentals 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	

Course L0414: Fundamentals of Ship Structural Analysis		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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	

Module M0664: S	tructural Design and Construction	on of Ships		
Courses				
Title Ship Structural Design (L04: Ship Structural Design (L04: Welding Technology (L1123	15)	Typ Lecture Recitation Section (small) Lecture	Hrs/wk 2 2 3	<b>CP</b> 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			
<b>Educational Objectives</b>	After taking part successfully, students have rea	ached the following learning	results	
Professional				
Competence Knowledge	Students can reproduce design and sizing as we and of different ship types (incl. detail design structures.			
Skills	Students are capable to specify the requirement design criteria for the components, to select structure			
Personal Competence				
Social Competence	Students are capable to present their structura group.	al design and discuss their d	ecisions con	structively in a
Autonomy	Students are capable to design independently ship types and to define appropriate fabrication		the ship hu	ll and different
Workload in Hours	Independent Study Time 172, Study Time in Lec	cture 98		
Credit points	9			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula	General Engineering Science (German progr Compulsory General Engineering Science (English progra Compulsory Naval Architecture: Core qualification: Compulso	am, 7 semester): Specialis		

Course L0412: Ship Structural Design		
Тур	Lecture	
Hrs/wk	2	
СР	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	

Tym	Recitation Section (small)
Hrs/wk	
СР	3
<b>Workload in Hours</b>	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

Course L1123: Welding	Technology
Тур	Lecture
Hrs/wk	3
СР	3
	Independent Study Time 48, Study Time in Lecture 42
	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	
Cycle	- phase transitions, phase diagrams and thermal activated processes
	- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
	- 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
Content	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal 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
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.  Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.  Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Module M1109: R	Resistance and Propulsion			
Product Prizing				
Courses				
Title		Тур	Hrs/wk	СР
Resistance and Propulsion ( Resistance and Propulsion (		Lecture Recitation Section (large)	2	3
	· · · · · · · · · · · · · · · · · · ·	Recitation Section (large)	2	3
Module Responsible Admission				
Requirements	INONE			
Recommended Previous Knowledge	■ Fluid Dynamics for Naval Architects			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning i	results	
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for redifferent resistance phenomena and their practical and empirical prediction methods are subject of resistances are dealt with. The course includes moships. This hold also for propulsion and hullefficien Focus is how hull forms can be optimized for minintopics are dealt with:  - Stillwater/added resistance, Wave resistance, Mimethods, friction laws, laminar/turbulent flow separates and pendage Design and resistance, Froude's resistance, model scaling laws, resistance tests, free rutests, full scale speed power predictions, addition EEDI, speed trials, contractual matters concerning	applications to hullform of the course. Furthermore del test techniques and the cy elements, mainly thrust num and sustainable fuel dinimization of wave resist aration, Hull form design for sistance law, form factor nning propeller tests and nal resistances (wind, ste	design as we e, environme neir applicati t deduction a consumption ance, numel or redcude fl method, thr propeller bas eering, curre	Il as numerical ntal additional on to full scale and wake. Main The following rical prediction ow separation, ust deduction, sics, propulsion
Skills	The student shall learn to design competitve hull numreical techniques and to evaluate these hulls will enable the student to clearl determine and minfluences.	by several progosis metho	ods. Furtermo	ore, the course
Personal Competence				
Social Competence	The student learns to prepare technical matters suvervision team.	in such a way that he ca	n compte wi	th his building
Autonomy	The student learns to prepare technical matters suvervision team.	in such a way that he ca	n compte wi	th his building
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	LIBU MIN			
Assignment for the Following Curricula		, 7 semester): Specialis		

Course 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: Resistar	urse L1266: Resistance and Propulsion	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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: H	ydrostatics and Body Plan			
Courses				
Title Hydrostatics (L1260) Hydrostatics (L1261) Body Plan (L1452)		Typ Lecture Recitation Section (large) Project Seminar	Hrs/wk 2 2 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in Mathemathics I-III and Mecha It is recommended that the students are familian GA- Plan, Tank Plan etc.		nt drawings,	e.g. Body Plan,
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
Professional Competence Knowledge	The lecture enables the student to carry out all necessary theoretical calculations for ship design on a			
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	The student gets access to hydrostatical problem	ns.		
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6			
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (English progra Compulsory Naval Architecture: Core qualification: Compulso	m, 7 semester): Speciali		

urse L1260: Hydrostatics	
-	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
	Prof. Stefan Krüger
Language	
Cycle	
	1. Numerical Integration, Diffrentation, Interpolation
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods
	- Determination of Areas, 1st and 2nd order Moments
	- Numerical Diffrentation, Spline Interpolation
	2. Buyoancy
	- 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
- Determination of COG from Metacentric height and from Cross Curves
- Roll Decay Test
- 8. Launching and Docking
  - Launching Plan, Arrangement of Launching Blocks
  - Rigid Body Launching: Tilting, Dumping, Equation of Techel
  - Computation of Launching Event
  - Bottom Pressure and Longitudinal Strength
  - Linear- Elastic Effects
  - Transversal Stability on Slipway and in Dock
- 9. Grounding
  - Loss of Buoynacy when Grounded
- Pointwise Grounding
- Ship Grounds on Keel
- 10. Introduction into Damage Stability Problems

	- Added Mass Method
	- Loss of Buoyant Volume Method
	- Simple Equilibrium Computations
	- Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
	- Water Ingress Through Openings
	11. Special Problems (optional and agreed upon)
	- e.g. Heavy Lift Operations
	- e.g. Jacking of Jackup Vessels
	- e.g. Sinking After Water Ingress
	1. Herner/Rusch: Die Theorie des Schiffes
	Fachbuchverlag Leipzig
Literature	Henschke     Schiffstechnisches Handbuch, Band 1     VEB Technik Verlag Berlin
	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Course 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: Fundamentals of Materials Science								
Courses								
Title Fundamentals of Materials Science I (L1085)		Typ Lecture	Hrs/wk	<b>CP</b> 2				
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture	2	2				
Physical and Chemical Basic	Physical and Chemical Basics of Materials Science (L1095) Lecture 2 2							
Module Responsible								
Admission Requirements	None							
Recommended Previous Knowledge								
Educational Objectives	After taking part successfully, students have reach	ned 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 mechanica properties. The students know about the key aspects of characterization methods for materials and car 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 phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.							
Personal Competence								
Social Competence	<del>}</del>							
Autonomy	;							
	I- Independent Study Time 96, Study Time in Lecture 84							
Credit points								
Examination								
Examination duration								
and scale								
Assignment for the Following Curricula								

Course L1085: Fundam	ourse 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: Fundam	entals 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

Course L1095: Physical	and Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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</li> <li>"Detour": Mathematics (complex e-funktion etc.)</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:         <ul> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter</li> </ul> </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: S	hip Design			
Courses				
Title Ship Design (L1262) Ship Design (L1264)	<b>Typ</b> Lecture Recitation Section (l		Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements				
Recommended Previous Knowledge	· · · · · · · · · · · · · · · · · · ·			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following lea	rning re	esults	
Professional Competence				
Knowledge	The lecture starts with an overview about the importance and requirements of the aerly design phase. Competitive Elements of Ship Designs are thoroughly discussed. Typical bulding contracts and the related technical risk are introduced. The most important main parameters of a ship are introduced and their influence on the competitiveness of a design. The lecture focusses on the influence of alternated main parameters on the total performance of a ship design and the consecutive process elements. In this lecture, the design changes are dealt with by simple models or formulae. The student shall further learn to model complex systems properly so that the relavent technical conclusions can be drawn.  The lecture continues with an introduction into the different phases of design project, from the initial design phase to a building contract. Further, methods are introduced to generate bulding specification relevant information at different levens of granularity during the different design stages. In detail, the following topics are adressed:  - Structure of a building specification - Determination of Light Ship Weight and Deadweight Components - Design of main section and hull form - Design of aftbody lines and manoevering devices - Design of main propulsion plant - Design of subdivision - Determination of limiting GMrequ- Curves - Scantlings of most improtant structural members - Longitudinal strength - Outfitting Components - Relevant rules and regulations			
Skills	The student is made familiar with the basic design principles of seage the lecture is that the student shall be able to carry out a conce comparison fulfilling typical contract requirements within the Marine with the basic design methods to determine the fundamantal technical with respect to fulfillment procedures of the contract values. Based Design" the relevant methods to determine and judge uopn the petreated.	pt desi Environal Environa	gn based onment. Th acteristics lecture "Pi	on a vessel of ne lecture deals of a ship design rinciples of Ship
Personal Competence				
Social Competence	The students learns to prepare technical matters in such a way th customer against his competitors.	e he c	an persua	de his potantial
Autonomy	The students learns to prepare technical matters in such a way th customer against his competitors.	ie he ca	an persuad	de his potantial
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
	Written exam			
Examination duration and scale	1180 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (English program, 7 semester): Sp Compulsory Naval Architecture: Core qualification: Compulsory			

Course L1262: Ship Des	ourse L1262: Ship Design	
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	
Content		
Literature		

Course L1264: Ship Design	
Тур	Recitation Section (large)
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
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				
<b>Title</b> Introduction into Process En Fundamentals of material e	gineering/Bioprocess Engineering (L0829) ngineering (L0830)	<b>Typ</b> Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 1 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following	learning results	
Professional Competence	After passing this module the students have  • give an overview of the most importa  • explain some working methods for di	ant fields on process and		ring,
Knowledge				
Skills	<ul> <li>After passing this module the students should have the ability to:</li> <li>list and outline the most important fields of process engineering,</li> <li>name the most important working approaches or methods of the different fields of process engineering,</li> <li>read and prepare an engineering drawing,</li> <li>explain the most important technologies for wastewater and exhaust air treatment</li> <li>scheme typical chemical and biotechnological processes independently with the aid of pointers.</li> </ul>			
Personal Competence	The students are able to			
Social Competence	<ul> <li>work out results in groups and docun</li> <li>provide appropriate feedback and ha</li> </ul>	•	own performance con	structively.
Autonomy	The students are able to estimate their pro of knowledge in Process Engineering and Bi		emselves and to delib	erate their la
Workload in Hours	Independent Study Time 34, Study Time in	Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German pr Compulsory General Engineering Science (German pro	ram): Specialisation Bio rogram, 7 semester):	process Engineering: Specialisation Proce	Compulsory ss Engineerin

Assignment for the	
Following Curricula	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, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
1	Process Engineering: Core qualification: Compulsory

Тур	Lecture
Hrs/wk	2
СР	1
<b>Workload in Hours</b>	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

Course L0830: Fundam	entals of material engineering
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: eine 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>

Module M0937: P	hysical Chemistry			
Courses				
<b>Title</b> 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 chem	istry, physics for engin	eers and mathe	matics I-III.
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed 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 underlying concepts of mass-, heat- and momentum transfer.  - to interpret phase diagrams and affiliate kinetic rate laws.  The students are able to			
Skills	<ul> <li>conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.</li> <li>assess new applications with respect to environmental sustainability.</li> <li>abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kinetic calculations.</li> </ul>			
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document experiments according to scientifi guidelines in small groups.  The students are able to reflect their subject-specific knowledge orally in a team and to discuss it wit fellow students and faculty.			
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 Lectur	e 56		
Credit points	3	· · · · · · · · · · · · · · · · · · ·		
Examination duration	Written exam			
Assignment for the	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 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 Elective Compulsory Process Engineering: Core qualification: 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. Volker Abetz
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>

Course LO	335: Physical Chemistry
Тур	Practical Course
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Volker Abetz
Language	DE
Cycle	WiSe
	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
Content	Heat of neutralization
Content	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.
	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
Literature	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html

Module M0730: C	Computer Engineering			
Courses				
<b>Title</b> Computer Engineering (L03)	•	cture	Hrs/wk	<b>CP</b> 4
Computer Engineering (L03)	24) Rec	citation Section (small)	1	2
Module Responsible				
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended	The successful completion of the labs will be ho examination according to the following rules:	onored during the ev	aluation of	the module
Previous Knowledge		examination's marks	are lifted b	
Educational Objectives	After taking part successfully, students have reached t	the following learning r	esults	
Professional		<u> </u>		
Competence	This module deals with the foundations of the function from the assembly-level programming down to gates.			
Knowledge	<ul> <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, pipelinin</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-poi connections, busses</li> </ul>			
Skills	The students perceive computer systems from the internal structure and the physical composition of conhighly specific and individual computers can be be components. They are able to distinguish between a today's computing systems - from gates and circuits up.  After successful completion of the module, the students.	mputer systems. The solid based on a colle nd to explain the differ p to complete processor	students car ection of fe erent abstrac ors.	analyze, how and simp
	between a physical computer system and the soft understand the consequences that the execution of s layers from the assembly language down to gates. impact that these low abstraction levels have on a feasible options.	tware executed on it software has on the ha This way, they will be	. In particul ordware-cent e enabled to	ar, they sha ric abstraction evaluate the
<b>Personal Competence</b>				
Social Competence	Students are able to solve similar problems alone or in	a group and to preser	t the results	accordingly.
Autonomy	Students are able to acquire new knowledge from sp with other classes.	ecific literature and to	associate t	his knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lecture 50	6		
Credit points				
Examination	Written exam			
Examination duration and scale	IUII MINIITAE CONTANTE OT COLITEA AND IANE			
	General Engineering Science (German program): Core General Engineering Science (German program, 7 Compulsory			outer Scienc
	General Engineering Science (German program, 7 se	emester): Specialisatio	n Bioproces	s Engineering
	Compulsory General Engineering Science (German program, 7	semester): Specialis	ation Naval	Architectur
	Compulsory General Engineering Science (German program,			
	Compulsory  General Engineering Science (German program, 7 s  Compulsory			
	General Engineering Science (German program, 7 se Compulsory	emester): Specialisatio	n Biomedica	ıl Engineerin
	[504]			

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** 

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 Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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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	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 M0536: F	undamentals of Fluid Me	echanics			
	undamentals of Fidia Me	echanics			
Courses					
Title		Ty	-	Hrs/wk	CP
Fundamentals of Fluid Mech Fluid Mechanics for Process			cture citation Section (large)	2	4 2
	1	Titel	citation Section (large)	-	
Module Responsible	i e e e e e e e e e e e e e e e e e e e				
Admission Requirements	None				
Recommended Previous Knowledge			equations		
<b>Educational Objectives</b>	After taking part successfully, stude	ents have reached t	the following learning	results	
Professional					
Competence	! !				
	Students are able to:				
Knowledge	<ul> <li>explain the difference betwee</li> <li>give an overview for difference</li> <li>engineering</li> <li>explain simplifications of the conditions</li> </ul>	rent applications o	of the Reynolds Tran		
	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 that 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 their 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 to present the results.</li> </ul>		o present their		
	l The students are able to				
Autonomy	<ul><li>search further literature for e</li><li>work on their exercises by th</li></ul>				
Workload in Hours	Independent Study Time 124, Study	y Time in Lecture 5	6		
Credit points	6				
Examination	Written exam				
Examination duration and scale	I 3 nours				
	General Engineering Science (Germ General Engineering Science (Germ General Engineering Science (Germ Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Gern Compulsory General Engineering Science (Gern	nan program): Speci nan program): Spec rman program, 7 man program, 7 se	ialisation Bioprocess E cialisation Energy and semester): Specialisa emester): Specialisation	Engineering: Enviroment ation Proces on Bioproces	Compulsory all Engineering: Engineering: Engineering:
	Engineering: Compulsory Bioprocess Engineering: Core qualif Energy and Environmental Engineer General Engineering Science (Englis General Engineering Science (Englis Compulsory General Engineering Science (Englis General Engineering Science (Englis General Engineering Science (Englis	fication: Compulsory ring: Core qualificat sh program): Specia ish program): Specia sh program): Specia	y tion: Compulsory alisation Bioprocess Er tialisation Energy and alisation Process Engir	ngineering: ( Enviroment neering: Com	Compulsory al Engineering npulsory

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
Process Engineering: Core qualification: Compulsory

Course L0091: Fundam	entals of Fluid Mechanics		
Тур	Lecture		
Hrs/wk	2		
СР	4		
<b>Workload in Hours</b>	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. 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>		

Course L0092: Fluid Me	Course L0092: Fluid Mechanics for Process Engineering			
Тур	Recitation Section (large)			
Hrs/wk				
СР	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>			

Module M0544: P	hase Equilibria Thermody	namics		
Courses				
<b>Title</b> Phase Equilibria Thermodyn Phase Equilibria Thermodyn		<b>Typ</b> Lecture Recitation Section (small	Hrs/wk 2 ) 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, The	rmodynamics I and II		
<b>Educational Objectives</b>	After taking part successfully, student	s have reached the following learnin	g results	
Professional Competence				
Knowledge	describe thermodynamic equilil  They learn how state variables quantitatively describe these p  Moreover, the students learn h phenomena may occur if d Furthermore the fundamentals  For different phase equilibria,	are influenced by the mixing of com	pounds and le ed mathemati lid) coexist erent kinds o	earn concepts to cally and which in equilibrium for processes ar
Skills	<ul> <li>Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how to simplify these equations meaningfully.</li> <li>The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve the resulting mathematical relations.</li> <li>For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameters in literature sources.</li> <li>Beside pure compound properties the students are capable of describing the properties of mixtures.</li> <li>The students know how to visualize phase equilibrial graphically and they know how to interpret the occurring phenomena.</li> <li>Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reaction processes in chemical engineering.</li> </ul>			
Personal Competence				
Social Competence	The students are able to work in sm them oraly to the tutors and other stu		ing problems	and to presen
Autonomy	<ul><li>judge their quality.</li><li>During the semester the stud</li></ul>	necessary information self-reliantly lents are able to check their learn edge the students can adept their lea	ing progress	continuously i
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points				
Examination				
Examination duration and scale		d calculations		
	General Engineering Science (German General Engineering Science (German General Engineering Science (Germ Compulsory General Engineering Science (Germa Compulsory Bioprocess Engineering: Core qualifica	program): Specialisation Bioprocess an program, 7 semester): Special n program, 7 semester): Specialisa ation: Compulsory	Engineering: isation Proce tion Bioproce	Compulsory ss Engineering ss Engineering
Following Curricula	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
Process Engineering: Core qualification: Compulsory

Course L0114: Phase E	quilibria 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: 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. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>

Course L0140: Phase E	quilibria Thermodynamics
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	
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: equilibrium condition, binary systems</li> <li>Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> <li>The students work on tasks in small groups and present their results in front of all students.</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 L0142: Phase E	quilibria Thermodynamics
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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. O ´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>

Courses		
Title	Typ Hrs/wk CP	
Signals and Systems (L0432 Signals and Systems (L0433		
Module Responsible		
Admission		
Requirements	None	
	Mathematics 1-3	
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as cover by the moduls Mathematik 1-3 is expected. Further experience with spectral transformations (Fourieseries, Fourier transform, Laplace transform) is useful but not required.	
Educational Objectives	After taking part successfully, students have 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 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 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.	
<b>Personal Competence</b>		
Social Competence	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They c control their level of knowledge during the lecture period by solving tutorial problems, software too clicker system.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	
Credit points	6	
	Written exam	
Examination duration and scale	I MIN MIN	
	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 Civil- and Environmental 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, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science 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 Biomedical 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 (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 Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical	
6 i	Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneerir	

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 Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0432: Signals	and Systems
Тур	Lecture
Hrs/wk	3
СР	
	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 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, Stuttgal 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 (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0938: B	ioprocess Engineering - Funda	mentals		
Courses				
<b>Title</b> Bioprocess Engineering - Fu Bioprocess Engineering- Fu Bioprocess Engineering - Fu		<b>Typ</b> Lecture Recitation Section (large) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Andreas Liese			
Admission Requirements				
Recommended Previous Knowledge		fundamentals for process engine	eering"	
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of the bibliometry and should be appropriate to the context of the bibliometry and should be appropriate to the context of the bibliometry and should be appropriate to the context of the bibliometry and should be appropriate to the context of the bibliometry and should be appropriate to the context of the con			
Skills	<ul> <li>describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters</li> <li>predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process</li> <li>analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations</li> <li>distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic aerobic as well as microaerobic) to compare them as well as to apply them to curren biotechnical problem</li> <li>propose solutions to complicated biotechnological problems and to deduce the corresponding 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>			
Personal Competence  Social Competence	After completion of this module participant teams to enhance the ability to take positi teamwork in engineering and scientific enviro	ion to their own opinions and		
Autonomy	After completion of this module participants will be able to solve a technical problem in a tean independently by organizing their workflow and to present their results in a plenum.		lem in a team	
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points				
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula			Compulsory ss Engineering: compulsory npulsory ss Engineering: ss Engineering: npulsory ry Compulsory	

Course L0841: Bioproce	ess Engineering - Fundamentals
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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>Technology of sterilization (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	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Course L0842: Bioproce	ess Engineering- Fundamentals
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
	1. Introduction (Prof. Liese, Prof. Zeng)
	2. Enzymatic kinetics (Prof. Liese)
	3. Stoichiometry I + II (Prof. Liese)
	4. Microbial Kinetics I+II (Prof. Zeng)
Content	5. Rheology (Prof. Liese)
	6. Mass transfer in bioprocess (Prof. Zeng)
	7. Continuous culture (Chemostat) (Prof. Zeng)
	8. Sterilisation (Prof. Zeng)
	9. Downstream processing (Prof. Liese)
	10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)
Literature	siehe Vorlesung

ourse L0843: Bioprocess Engineering - Fundamental Practical Course		
Тур	Practical Course	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Module M1497: M	leasurement Technology f	or VT/ BVT		
Courses				
<b>Title</b> Practical Course Measurement Measurement Technology (I Physical Fundamentals of M	3, . ,	<b>Typ</b> Practical Course Lecture Lecture	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students	s have reached the following	learning results	_
Professional Competence				
Knowledge				
Skills				
Personal Competence  Social Competence				
Autonomy				
	Independent Study Time 96, Study Tin	ne in Lecture 84		
Credit points				
Examination				
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (Germa Compulsory Bioprocess Engineering: Core qualifica General Engineering Science (Englis Compulsory Orientierungsstudium: Core qualificatio Process Engineering: Core qualification	tion: Compulsory th program, 7 semester): !		

Course L2270: Practica	ourse L2270: Practical Course Measurement Technology		
Тур	Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Course L2268: Measure	ourse L2268: Measurement Technology	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandra von Kameke	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L2269: Physical	urse L2269: Physical Fundamentals of Measurement Technology		
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Christian Schroer		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Module M0538: H	leat and Mass Transfer			
Courses				
<b>Title</b> Heat and Mass Transfer (L0: Heat and Mass Transfer (L0: Heat and Mass Transfer (L1:	102)	<b>Typ</b> Lecture Recitation Section (small Recitation Section (large		<b>CP</b> 2 2 2
Module Responsible		, 3		
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge: Technical Therm	nodynamics		
Educational Objectives	After taking part successfully, stud	dents have reached the following learning	g results	
Professional Competence		-		
Knowledge	procedural apparatus (e. g. They are capable of distin namely heat conduction, he The students have the abidescribe mass transfer qua	of explaining qualitative and determining heat exchanger, chemical reactors). Iguish and characterize different kinds deat transfer and thermal radiation. If you can be explain the physical basis for mulitative and quantitative by using suitable analogy between heat- and mass transfer and mass transfer explain the physical basis for mulitative and quantitative by using suitable analogy between heat- and mass transfer explain the physical basis for mulitative and quantitative by using suitable explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and mass transfer explain the physical basis for mulitative and ph	of heat trans ass transfer e mass transf	fer mechanisn in detail and er theories.
Skills	<ul> <li>The students are able to set reasonable system boundaries for a given transport problem to using the gained knowledge and to balance the corresponding energy and mass flow respectively.</li> <li>They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows.</li> <li>Using dimensionless quantities, the students can execute scaling up of technical processes of apparatus.</li> <li>They are able to distinguish between diffusion, convective mass transition and mass transfer They can use this knowledge for the description and design of apparatus (e.g. extraction column).</li> <li>In this context, the students are capable to choose and design fundamental types of heat are mass exchanger for a specific application considering their advantages and disadvantage respectively.</li> <li>In addition, they can calculate both, steady-state and non-steady-state processes in procedur apparatus.</li> <li>The students are capable to connect their knowledge obtained in this course with knowledge other courses (In particular the courses thermodynamics, fluid mechanics and chemical processengineering) to solve concrete technical problems.</li> </ul>			
Personal Competence				
Social Competence	and the same Harrison and a second of	to work on subject-specific challenges le manner to tutors and other students.	in teams and	I to present th
Autonomy	<ul> <li>The students are able to find and evaluate necessary information from suitable sources</li> <li>They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study	dy Time in Lecture 56		
Credit points				
Examination				
Examination duration		and advisors		

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Course L0101: Heat and Mass Transfer		
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	1. Heat transfer  Introduction, one-dimensional heat conduction  Convective heat transfer  Multidimensional heat conduction  Non-steady heat conduction  Thermal radiation  Mass transfer  one-way diffusion, equimolar countercurrent diffusion  boundary layer theory, non-steady mass transfer  Heat and mass transfer single particle/ fixed bed  Mass transfer and chemical reactions	
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

Course L1868: Heat an	urse L1868: Heat and Mass Transfer	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	

Module M0546: T	hermal Separation Processes			
Courses				
<b>Title</b> Thermal Separation Process Thermal Separation Process Thermal Separation Process	ses (L0119) ses (L0141)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 2 1
Separation Processes (L115	· 1	Practical Course	1	1
Module Responsible Admission	None			
Requirements  Recommended  Previous Knowledge	Recommended requirements: Thermodynamics II	I		
Educational Objectives	After taking part successfully, students have read	thed the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can distinguish and descrit distillation, extraction, and adsorption</li> <li>The students develop an understanding process, the estimation of the energy dereand the selection of separation systems</li> <li>They have good knowledge of designing meaning /li></ul>	for the course of concent mand of a process, the po	tration durir ssibilities of	ng a separatio energy saving
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a giv 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 process a 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 based the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties from 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 of the experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use together for the solution of technical problems. Other lectures such as thermodynamics, flumechanics and chemical engineering.</li> </ul>		ion process and nease based of properties from b work. The experimental stures and use in the control of the co	
Personal Competence				
Social Competence	<ul> <li>The students can work technical assignme in the tutorial</li> <li>The students are able to carry out practic division of labor between them. They are scientifically in a report.</li> </ul>	al lab work in small group	s and organ	ize a functiona
Autonomy	<ul> <li>The students are capable to obtain the needed information from suitable sources by themselved and assess their quality</li> <li>The students can proof the state of their knowledge with exam resembling assignments and this way control their learning process</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points				
-	Written exam			
Examination duration and scale	1170 minutes, theoretical difestions and calcillation	ns		
	General Engineering Science (German prograr Compulsory General Engineering Science (German program,			

Assignment for the Following Curricula	
	Engineering: Compulsory Process Engineering: Core qualification: Compulsory

Course L0118: Therma	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 Technischen Chemie</li> </ul>

Course L0119: Thermal	Separation Processes
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> The students work on tasks in small groups and present their results in front of all students.
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>

Course 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>

Course L1159: Separation Processes		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.	
Lecturer	Prof. Irina Smirnova	
Language	DE/EN	
Cycle	WiSe	
Content	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.  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 on their own reports and level of scientific writing so they can increase their capabilities in this area.  Topics of the practical course:  Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Advance overview of separation processes Selection of separation processes	
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: Chemical Reaction Engineering

Courses				
Title		Тур	Hrs/wk	СР
_	ring (Fundamentals) (L0204)	Lecture	2	2
	ring (Fundamentals) (L0244)	Recitation Section (large)	2	2
Experimental Course Chemi	cal Engineering (Fundamentals) (L0221)	Practical Course	2	2
Module Responsible				
Admission Requirements	None			
	Contents of the previous modules mathematics as well as computational methods for engineers		hnical therr	modynamics I+
<b>Educational Objectives</b>	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 pout differences between thermodynamical and kinetical processes. The students have a strong abit to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties.		a strong abili	
	After successful completion of the module, stud	ents are able to:		
	- apply different computational methods to dime	ension isothermal and non-is	othermal id	eal reactors,
Skills	- determine and compute stable operation point	s for these reactors ,		
	- conduct experiments on a lab-scale pilot plant	s and document these accord	ding to scie	ntific guideline
<b>Personal Competence</b>				
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themself- in small groups to solve issues in chemical reaction engineering. The students can discuss their subje- related knowledge among each other and with their teachers.			
Autonomy	The students are able to obtain further informa can apply their knowldege discretely to plan, pr			nously. Studen
<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German prograt Compulsory General Engineering Science (German prograt Compulsory Bioprocess Engineering: Core qualification: Com Bioprocess Engineering: Core qualification: Com General Engineering Science (English prograt Compulsory General Engineering Science (English prograt Compulsory Process Engineering: Core qualification: Compul Process Engineering: Core qualification: Compul	m, 7 semester): Specialisation ipulsory ipulsory im, 7 semester): Specialisation in, 7 semester): Specialisation	on Bioproce	ess Engineerin

Course L0204: Chemica	al Reaction Engineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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
	1000

complex reactions)

Content

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 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

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
- $\mbox{H.\,S.}$  Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall **Literature** 
  - 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: Chemica	ourse L0244: Chemical Reaction Engineering (Fundamentals)		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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 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, molebalance 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:

Content

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

· .	ental Course Chemical Engineering (Fundamentals)			
	Practical Course			
Hrs/wk				
СР				
	Independent Study Time 32, Study Time in Lecture 28			
	Prof. Raimund Horn, Dr. Achim Bartsch			
Language	DE/EN			
Cycle				
	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			
	Skript Chemische Verfahrenstechnik 1 (F.Keil)			

Module M1275: E	nvironmental Technology					
Courses						
Title Practical Exercise Environmental Technology (L1387) Environmental Technologie (L0326)		<b>Typ</b> Practical Course Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2		
	Prof. Martin Kaltschmitt					
Admission Requirements	None					
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry and biology					
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results					
Professional Competence						
Knowledge	With the completion of this modul the students obtain profound knowledge of environmental 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 environmental problems. They are able to determine geochemical parameters and to assess the potential of 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 multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.					
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 in Lecture 42					
Credit points	3					
Examination						
Examination duration and scale	1 hour					
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: 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					

Course L1387: Practica	Exercise Environmental Technology
Тур	Practical Course
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	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.
	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

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, Dozenten des SD V
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>
	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

0				
Courses			, .	
<b>Title</b> Introduction to Control Syst	ems (L0654)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Introduction to Control Syst		Recitation Section (small)		2
Module Responsible	Prof. Herbert Werner			
Admission				
Requirements	Representation of signals and systems	s in time and frequency domain. Lapla	ce transform	<u> </u>
Recommended Previous Knowledge		on time and nequency domain, Lapla	ce transform	•
<b>Educational Objectives</b>	After taking part successfully, student	s 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 term 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 an 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 and frequen response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time a 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, and experimentally validate th		ly validate the	
	controller designs  Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems.		documentation	
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		ng progress.	
	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points	6   Written exam			
Examination duration				
and scale				
	General Engineering Science (Gern	nan program, 7 semester): Special	isation Com	nputer Science
	Compulsory General Engineering Science (Germa	n program, 7 semester): Specialisati	on Bioproce	ss Engineerin
	Compulsory General Engineering Science (Germ	nan program 7 samester). Special	isation Nav	al Architectur
	Compulsory			
	General Engineering Science (Gerr Compulsory	man program, 7 semester): Specia	alisation Civ	ril Engineering
	General Engineering Science (Germa	an program, 7 semester): Specialisa	tion Electric	al Engineerin
	Compulsory General Engineering Science (Germa	n program, 7 semester). Specialisati	on Biomedic	al Engineering
	Compulsory			
	General Engineering Science (German Engineering: Compulsory	n program, 7 semester): Specialisatio	n Energy ar	d Enviroment
	General Engineering Science (Germ Compulsory	an program, 7 semester): Specialis	ation Proce	ss Engineerin
	General Engineering Science (Germa	n program, 7 semester): Specialisati	on Mechanic	al 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, 7 semester): Specialisation Computer Science:

Compulsory

Assignment for the

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

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: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 plots Root locus design of PID controllers  Frequency response techniques
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, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>

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

Module M0539: P	rocess and Plant Engineering I			
Courses				
Title Process and Plant Engineeri Process and Plant Engineeri Process and Plant Engineeri	ng I (L0096)	Typ Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof Georg Fieg			
Admission				
Recommended Previous Knowledge	unit operation of thermal an dmechanical separation processes chemical reactor eingineering			
<b>Educational Objectives</b>	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
classify and formulate blobal balance equations of chemical processes  **Rnowledge**  specify linear component equations of complex chemical processes  explain linear regression and data reconcilliation problems  explain pfd-diagrams		chemical processes		
Skills	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 Le	cture 56		
Credit points				
Examination Examination duration and scale				
Assignment for the	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German prograr Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Con General Engineering Science (English progra Compulsory General Engineering Science (English prograr Compulsory General Engineering Science (English program Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory	m, 7 semester): Specialisation, 7 semester): Specialisation npulsory am, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation	on Bioproce n Energy an ation Proces on Bioproce	ss Engineering: d Enviromental ss Engineering: ss Engineering:

Course L0095: Process and Plant Engineering I		
Typ Lecture		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg	
Language	DE	

Cycle	SoSe
Content	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
Literature	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 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. 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, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98 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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course 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	
en_mh_head_studienleistung	none	
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0670: P	article Technology and Solids	Process Engineering		
Courses				
<b>Title</b> Particle Technology I (L0434) Particle Technology I (L0440) Particle Technology I (L0440)	5)	<b>Typ</b> Lecture Recitation Section (small) Practical Course	Hrs/wk 2 1 2	<b>CP</b> 3 1 2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous Knowledge	keine			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence	After successful completion of the module st	udents are able to		
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	Students are able to  • choose and design apparatuses and processes for solids processing according to the desired solids properties of the product  • asses solids with respect to their behavior in solids processing steps  • document their work scientifically.			
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 quest	tions regarding solid particles in	dependently	у.
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following Curricula				

Course L0434: Particle Technology I			
Тур	Typ 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>		
_	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	ırse 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	

Course L0440: Particle	Technology 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: F	oundations of Management			
Courses				
Title Management Tutorial (L088 Introduction to Managemen		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives Professional	After taking part successfully, students have reach	ed the following learning	results	
Competence				
Knowledge	After taking this module, students know the impo Management, from Planning and Organisation to M Controlling. In particular they are able to  • explain the differences between Econom Management and to name important definit • explain the most important aspects of and aspects of entreprneurial projects • describe and explain basic business function chain management, organization and huma innovation management and marketing • explain the relevance of planning and demultiple objectives and uncertainty, and Finance • state basics from accounting and costing and	Marketing and Innovation, nics and Management a ions from the field of Management and goals in Management and ons as production, procure n ressource management cision making in Busines explain some basic me	and also to land the sulagement domains the ement and so, informations, esp. in sethods from	nvestment and p-disciplines in most important ourcing, supply n management, ituations under
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 risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems			
Personal Competence				
Social Competence	work successfully in a team of students     to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project     to communicate appropriately and     to cooperate respectfully with their fellow students.			
	Students are able to			
Autonomy	<ul> <li>work in a team and to organize the team the</li> <li>to write a report on their project.</li> </ul>	emselves		
Workload in Hours	J Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	<u> </u>			
Examination	Subject theoretical and practical work			
Examination duration and scale	iseveral written exams diiring the semester			
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialis	ation Proces on Biomedic sation Nava sation Com	ss Engineering: al Engineering: il Architecture: puter Science:

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

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental 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

**Following Curricula** 

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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 Environmental 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

Orientierungsstudium: Core qualification: Elective Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

Course L0880: Introduc	ction to Management
Тур	Lecture
Hrs/wk	3
СР	3
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. Kathrin 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 in 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, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic 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	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M0891: In	nformatics for Process Engine	ers		
Courses				
Title Informatics for Process Engi Informatics for Process Engi Numeric and Matlab (L0125	ineers (L0837)	<b>Typ</b> Lecture Recitation Section (small) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Dr. Marcus Venzke			
Requirements	Notie			
Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence <i>Knowledge</i>	Students can describe procedural and object	t-oriented concepts.		
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 solutions toge	ther in small groups.		
Autonomy	Students are able to assess acquired skills b	y applying it in practice.		
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and 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 General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory Process Engineering: Core qualification: Compulsory			

Course L0836: Informat	ourse L0836: Informatics for Process Engineers		
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Marcus Venzke		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction to object-oriented modelling and programming exemplified with Java</li> <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/		

irse LU837: Informa	tics for Process Engineers
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
	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
СР	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):  1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004  2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007  3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de  4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Module M1274: E	nvironmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment		Lecture	2	2
Environmental Assessment	(L1054)	Recitation Section (small)	1	1
-	Prof. Martin Kaltschmitt			
Admission Requirements				
-	Fundamentals of inorganic/organic chemistry and	biology		
Educational Objectives	After taking part successfully, students have reach	ned 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 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.		ses, projects or e competent in es the students certainties and	
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 and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business context and are able to judge results of other publications.			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	e 42		
Credit points	3			
	Written exam			
Examination duration and scale	I I halir writtan avam			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory Process Engineering: Core qualification: Elective Compulsory Process Engineering: Core qualification: Elective 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		
	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	
Content	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	
	Foliensätze der Vorlesung	
Literature	Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	

Course L1054: Environ	mental 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, Dr. Anne Rödl
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

Module M-001: Ba	achelor Thesis		
Courses			
Title	Тур	Hrs/wk	СР
Module Responsible	Professoren der TUHH		
	According to Conoral Regulations \$21 (1).		
Admission Requirements	<ul> <li>According to General Regulations §21 (1):</li> <li>At least 126 ECTS credit points have to be achieved in study p board decides on exceptions.</li> </ul>	rogramme. Th	e examinations
Recommended			
Previous Knowledge Educational Objectives	After taking part successfully, students have reached the following learnin	na results	
Professional Competence		ig resures	
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 a 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 audience 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 that</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	12		
Examination			
Examination duration and scale	According to General Regulations		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Thesis: Com Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory Digital Mechanical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory Engineering Science: Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory		

	Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory Process Engineering: Thesis: Compulsory
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